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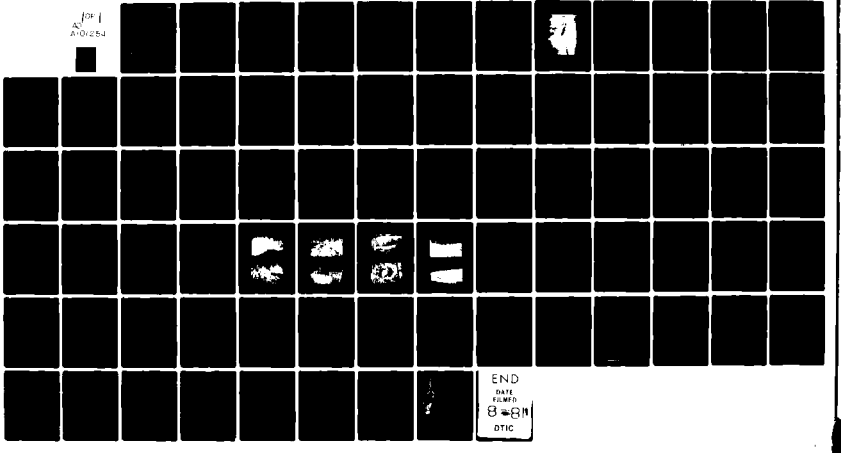

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DELAWARE RIVER BASIN

ARIEL CREEK, WAYNE COUNTY

PENNSYLVANIA

LEVEL II

WILDWOOD LAKE DAM

NDI ID NO. PA-00157
DER ID NO. 64-30

WILDWOOD PARK OUTING CLUB, INC.

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

National Dam Inspection Program. Wildwood Lake Dam (NDI ID Number PA-00157, DER ID Number 64-30), Delaware River Basin, Ariel Creek, Wayne County, Pennsylvania. Phase I Inspection Report.

Prepared by
GANNETT FLEMING CORDDRY AND CARPENTER, INC.
Consulting Engineers
Harrisburg, Pennsylvania 17105

"Original contains color plates: All DTIC reproductions will be in black and white"

DACW31-81-C-0018

For

DEPARTMENT OF THE ARMY
Baltimore District, Corps of Engineers
Baltimore, Maryland 21203

MARCH 1981

DELAWARE RIVER BASIN

ARIEL CREEK, WAYNE COUNTY

PENNSYLVANIA

WILDWOOD LAKE DAM

NDI ID No. PA-00157
DER ID No. 64-30

WILDWOOD PARK OUTING CLUB, INC.

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

Prepared by

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
Consulting Engineers
P.O. Box 1963
Harrisburg, Pennsylvania 17105

For

DEPARTMENT OF THE ARMY
Baltimore District, Corps of Engineers
Baltimore, Maryland 21203

MARCH 1981

PREFACE

This report is prepared under guidance contained in Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigations, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I Investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The spillway design flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

WILDWOOD LAKE DAM

NDI ID No. PA-00157; DER ID No. 64-30

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

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APPENDICES

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

BRIEF ASSESSMENT OF GENERAL CONDITION

AND

RECOMMENDED ACTION

Name of Dam:	Wildwood Lake Dam NDI ID No. PA-00157 DER ID No. 64-30
Size:	Small (18 feet high; 644 acre-ft.)
Hazard Classification:	High
Owner:	Wildwood Park Outing Club, Inc. c/o Atty. George Teets R.D. 1 Moscow, PA 18444
State Located:	Pennsylvania
County Located:	Wayne
Stream:	Ariel Creek
Date of Inspection:	12 November 1980

Based on visual inspection, available records, calculations, past operational performance, and according to criteria established for these studies, Wildwood Lake Dam is judged to be in fair condition. Based on the size and hazard classification of the dam, the Spillway Design Flood (SDF) at the dam varies between 1/2 the Probable Maximum Flood (PMF) and the PMF. Based on the downstream conditions, the selected SDF is the PMF. Under existing conditions, the spillway will pass about 48 percent of the PMF without overtopping of the dam. It is judged that the dam could withstand the depth and duration of overtopping that would occur during the 1/2 PMF. If the low areas on the top of the dam were filled to the design elevation, the spillway would pass about 62 percent of the PMF without any overtopping. For either condition, the spillway capacity is rated as inadequate. Both conditions were assessed without considering failure of an unnamed dam located 0.7 mile upstream from Wildwood Lake Dam. The upstream dam will pass less than about 5 percent of the PMF, and it is judged that the dam would fail

during the 1/2 PMF, and probably during floods smaller than the 1/2 PMF. If the upstream dam were to fail, it could cause Wildwood Lake Dam to be overtopped and fail during floods smaller than those Wildwood Lake Dam could normally withstand.

No immediate stability problems were evident at the time of the inspection, but deficiencies do exist that could eventually affect the stability of the dam.

Maintenance of the dam is considered inadequate.

The following remedial measures are recommended to be undertaken by the Owner, in approximate order of priority, without delay:

(1) Fill all low areas on the top of the dam to the design elevation of 1363.5.

(2) Provide equipment as required for removal of debris that might collect on the spillway bridge supports during floods.

(3) Remove all brush and trees from the slopes of the embankment.

(4) Make modifications as required to ensure access to the valve operating mechanism under all conditions and restore the mechanism to its full operating condition.

(5) Visually monitor the condition of the chute joints and the concrete and stone apron. If conditions worsen, design and construct remedial measures.

(6) Provide a means for preventing erosion at the toe of the dam in the event of prolonged outlet works discharge.

All designs, and inspection of construction should be performed by a professional engineer experienced in the design and construction of dams.

In addition, the Owner should institute the following operational and maintenance procedures:

(1) Develop a detailed emergency operation and warning system for Wildwood Lake Dam. When warnings of a storm of major proportions are given by the National Weather Service, the Owner should activate his emergency operation and warning system.

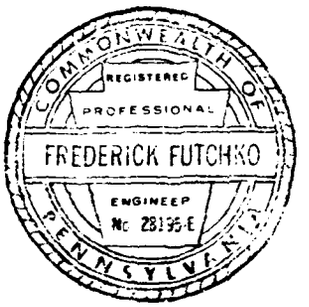
(2) During periods of unusually heavy rains, provide round-the-clock surveillance of Wildwood Lake Dam.

(3) As presently required by the Commonwealth, institute a program of formal annual inspections by a professional engineer experienced in the design and construction of dams. Utilize the inspection results to determine if remedial measures are necessary.

WILDWOOD LAKE DAM

Submitted by:

GANNETT FLEMING CORDDRY
AND CARPENTER, INC.



FREDERICK FUTCHKO
Project Manager, Dam Section

Date: 13 April 1981

Approved by:

DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT,
CORPS OF ENGINEERS

JAMES W. PECK
Colonel, Corps of Engineers
District Engineer

Date: 11 MAY 81

WILDWOOD LAKE DAM

Overview

WILDWOOD LAKE DAM

NDI ID No. PA-00157; DER ID No. 64-30

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

SECTION 1

PROJECT INFORMATION

1.1 General.

a. Authority. The Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of inspection of dams throughout the United States.

b. Purpose. The purpose of the inspection is to determine if the dam constitutes a hazard to human life or property.

1.2 Description of Project

a. Dam and Appurtenances. Wildwood Lake Dam consists of an earthen embankment, an overflow spillway, and an outlet works. The embankment is zoned, consisting of an impervious central core with random fill zones on each side. The embankment is 445 feet long and 18 feet high at the highest section of the dam.

The spillway is located at the highest section of the dam. A concrete-lined approach channel leads from the reservoir to a triangular, concrete weir. A footbridge with three supports spans the approach channel. The crest of the spillway weir is 55.3 feet long and 5.5 feet below the design level for the top of the dam. A steep concrete chute conveys the water to the downstream toe. A concrete and stone apron is located at the bottom of the chute.

The outlet conduit is a 24-inch diameter concrete pipe. A gate valve is located at the upstream end of the conduit, and there is a small concrete outlet structure at the downstream end. The various features of the dam are shown on the Photographs in Appendix C and on the Plates in Appendix E. A description of the geology is included in Appendix F.

b. Location. Wildwood Lake Dam is located on Ariel Creek in Lake Township, Wayne County, Pennsylvania, approximately 4 miles west of Lakeville. Wildwood Lake Dam is located on USGS Quadrangle, Lakeville, Pennsylvania, at latitude N 41° 26' 35" and longitude W 75° 20' 50". A location map is shown on Plate E-1.

c. Size Classification. Small (18 feet high, 644 acre-feet).

d. Hazard Classification. High hazard. Downstream conditions indicate that a high hazard classification is warranted for Wildwood Lake Dam (Paragraphs 3.1e and 5.1c (5)).

e. Ownership. Wildwood Park Outing Club, Inc., c/o Atty. George Teets, R.D. 1, Moscow, PA 18444.

f. Purpose of Dam. Recreation.

g. Design and Construction History. An earth and rockfill dam was constructed at the site sometime prior to 1917. The dam was about 8 feet high and about 250 feet long. Minor maintenance work was performed throughout the period from 1917 until 1955. In August 1955, a flood occurred that apparently caused overtopping failure of the dam. Reportedly, the breach was about 50 feet long and extended 8 feet into the foundation.

A design for reconstructing a dam at the site was prepared by James A. Scandale, Consulting Engineer, of Scranton, Pennsylvania in 1955. The design included provisions for raising and lengthening the dam, constructing a new spillway, and constructing an outlet works. Due to the extent of the reconstruction, only small remnants of the original structure were used in the work. The work was completed in 1956. Since that time, there have been no major modifications.

h. Normal Operational Procedure. The pool is maintained at the spillway crest level with excess inflow discharging over the spillway. The outlet works is used occasionally to draw down the pool level for maintenance purposes.

1.3 Pertinent Data.

a. Drainage Area. (square miles) 2.24

b.	Discharge at Damsite. (cfs.)	
	Maximum known flood at damsite	Unknown
	Outlet works at maximum pool elevation	64
	Spillway capacity at maximum pool elevation	
	Design conditions	2,710
	Existing conditions	2,070
c.	Elevation. (feet above msl.)	
	Top of dam	
	Design conditions	1363.5
	Existing conditions	1362.6
	Maximum pool	
	Design conditions	1363.5
	Existing conditions	1362.6
	Normal pool (spillway crest)	1358.0
	Upstream invert outlet works	1354.0
	Downstream invert outlet works	1349.5
	Streambed at toe of dam	1345.0
d.	Reservoir Length. (miles)	
	Normal pool	0.64
	Maximum pool (design)	0.68
e.	Storage. (acre-feet)	
	Normal pool	290
	Maximum pool (design)	724
	Maximum pool (existing)	644
f.	Reservoir Surface. (acres)	
	Normal pool	67
	Maximum pool (design)	92
	Maximum pool (existing)	87
g.	Dam.	
	Type	Zoned earthfill
	Length (feet)	445, embankment only
	Height (feet)	18
	Topwidth (feet)	
	Design	9.8
	Existing	8.0

g.	Dam (cont'd.)	
	Sides Slopes	
	Upstream	
	Design	1V on 3.0H
	Existing	1V on 2.75H
	Downstream	
	Design	1V on 2H
	Existing	1V on 1.9H
	Zoning	Impervious central core; two random zones
	Cutoff	Cutoff trench filled with impervious material
	Grout Curtain	None
h.	Diversion and Regulating Tunnel.	None
i.	Spillway.	
	Type	Concrete triangular weir and concrete chute
	Length of Weir (feet)	55.3
	Crest Elevation	1358.0
	Upstream Channel	Concrete-lined approach channel
	Downstream Channel	Concrete and stone apron
j.	Regulating Outlets.	
	Type	One 24-inch diameter concrete pipe

j.	Regulating Outlets (continued) Length (feet)	48
	Closure	24-inch gate valve at upstream end
	Access	Walkway extending from upstream slope

SECTION 2

ENGINEERING DATA

2.1 Design.

a. Data Available. Data available include a report prepared in 1917 by the Pennsylvania Water Supply Commission (PWSC), design drawings for the 1956 reconstruction, a permit application report prepared by the Commonwealth in 1955, and miscellaneous correspondence.

b. Design Features. The project is described in Paragraph 1.2a. The various features of the dam are shown on the Photographs in Appendix C and on the Plates in Appendix E.

c. Design Considerations. There are two concerns arising from review of the design data. The first is that no underdrainage facilities were provided beneath the spillway chute slab. The slab is only 1 foot thick, and it could be vulnerable to damage resulting from uplift pressures that might develop under high pool level conditions. Some mitigation of uplift pressures will occur as a result of a seepage cutoff wall that was included at the upstream end of the chute, but a potential for damage might still exist. The second concern is that the area where the foundation was scoured to an 8-foot depth was filled with rockfill and then covered with embankment material. No intervening filter layer was used between the rockfill and the foundation or between the rockfill and the enbankment material. If seepage were to develop, piping (internal erosion) of foundation or embankment soil into the rockfill might occur.

2.2 Construction Data.

a. Data Available. The only construction data available was a letter to the Commonwealth from the Owner certifying that the work was performed in accordance with the approved plans and specifications.

b. Construction Considerations. The available data are insufficient to assess the construction of the dam.

2.3 Operation. There are no formal records of operation. Correspondence indicates that there have been no significant problems since the dam was reconstructed in 1956.

2.4 Evaluation.

a. Availability. Engineering data were provided by the Bureau of Dams and Waterway Management, Department of Environmental Resources, Commonwealth of Pennsylvania (PennDER). Representatives of the Owner were available for information during the visual inspection.

b. Adequacy. The type and amount of available design data and other engineering data are fair, and the assessment is based on the combination of available data, visual inspection, performance history, hydrologic and hydraulic assumptions, and calculations developed for this report.

c. Validity. There is no reason to question the validity of the available data.

SECTION 3

VISUAL INSPECTION

3.1 Findings.

a. General. The overall appearance of the dam is fair. Some deficiencies were observed as noted below. A sketch of the dam with the locations of deficiencies is presented on Exhibit B-1 in Appendix B. Survey information acquired for this Report is summarized in Appendix B. Datum used for the survey was the spillway crest level, Elevation 1358.0. On the day of the inspection, the pool was at the spillway crest level.

b. Embankment. The top of the dam is 8 feet wide and covered with a growth of grass (Photograph A). The survey data show that elevations along the top of the dam vary from a low point adjacent to the spillway at Elevation 1362.6 to the design elevation of 1363.5 at the abutments.

Riprap on the upstream slope is generally in good condition, but some portions of the slope are overgrown with brush and trees (Photograph B). The upstream slope is slightly steeper than the design value of 1V on 3H.

The downstream slope of the dam is completely covered with a growth of brush and small trees (Photograph C). The downstream slope is approximately equal to the design value of 1V on 2H. There were no indications of slope instability, and no seepage or wet areas were apparent.

c. Appurtenant Structures. The spillway is in fair condition (Photographs C and D). There is some minor deterioration of the concrete at the upstream end of the left approach wall, and there is one crack in the right approach wall. A footbridge supported by three pairs of steel columns spans the approach channel (Photograph D). The low steel of the footbridge is at the level of the design elevation for the top of the dam. There was no debris in the approach channel on the day of the inspection. The concrete weir and chute are in fair condition. There is some deterioration along the chute slab joints and on the concrete and stone apron at the bottom of the chute. There was a slight amount of leakage at the deteriorated areas.

The outlet works is in fair condition. A bridge leading from the upstream slope to the valve operating mechanism has some missing boards (Photograph E). The valve was originally operated by a stem and handwheel. It was reportedly damaged by ice, and the caretaker now uses a jack to open it. The valve seals tightly and has no leakage. The valve was reportedly operated within the past year, and no problems were encountered. The 24-inch diameter concrete conduit and the concrete outlet structure at its downstream end are in good condition (Photograph F). There is no well-defined outlet channel for flow from the outlet works. Flow would travel along or near the toe of the dam until it entered the streambed located about 100 feet to the right.

d. Reservoir Area. The watershed is mostly wooded and has moderate slopes. A portion of the watershed has been developed, but few trees have been cut and disturbance of the landscape has been minimal. There is an unnamed dam located within the watershed area 0.7 mile upstream from Wildwood Lake Dam (Photograph G). The dam is about 10 feet high and 115 feet long. It is earthfill and dry stone masonry construction. There is no PennDER identification number for the dam.

e. Downstream Conditions. Immediately downstream from Wildwood Lake Dam, the stream channel is moderately steep and the valley is wooded. Ariel Creek goes under a secondary road about 600 feet downstream from the dam. About 1,000 feet downstream, Ariel Creek enters Roamingwoods Lake. Roamingwoods Lake Dam, located 1.4 miles downstream, is a 32-foot high earthfill dam (Photograph H). Roamingwoods Lake Dam (NDI ID No. PA-00166; DER I.D. No. 64-191) was inspected in June 1978 by Woodward-Clyde Consultants. The Phase I Report for the dam indicates that it is a high hazard dam, and that its spillway capacity is rated as inadequate.

SECTION 4

OPERATIONAL PROCEDURES

4.1 Procedure. The reservoir is normally maintained at spillway crest level, with excess inflow discharging over the spillway and into Ariel Creek. The outlet works is used occasionally to draw down the pool for maintenance purposes.

4.2 Maintenance of Dam. The dam is visited daily by the caretaker, who lives in a house adjacent to the dam. The need for maintenance is determined by members of the Wildwood Park Outing Club, and the work is normally performed by the caretaker. Formal inspections of the dam are not made.

4.3 Maintenance of Operating Facilities. The outlet works operating mechanism has not been maintained in its original condition, but it is reported to be operable by using a jack. The bridge from the upstream slope of the dam to the operating mechanism is in need of repairs.

4.4 Warning Systems in Effect. There is no emergency operation and warning system.

4.5 Evaluation of Operational Adequacy. The maintenance of the dam and appurtenant works is inadequate, as evidenced by the maintenance deficiencies observed during the visual inspection. The daily inspection of the dam by the caretaker is good, but a program of formal annual inspection is necessary to detect potentially hazardous conditions. A detailed emergency operation and warning system is necessary to reduce the risk of dam failure should adverse conditions develop and to prevent loss of life should the dam fail.

SECTION 5

HYDROLOGY AND HYDRAULICS

5.1 Evaluation of Features.

a. Design Data. The permit application report for the 1956 reconstruction indicates that the design capacity of the spillway was to be 2,060 cfs, which was considered suitable for a 2.6-square mile drainage area. The design capacity was based on a spillway length of 42.5 feet, a maximum head of 5.5 feet, and a discharge coefficient of 3.8. Although no mention of departure from the plans is included in the records, the spillway length actually constructed was 55.3 feet. The maximum head at the spillway is the same as was used for design. Due to the increase in length, the design capacity of the spillway is actually 2,710 cfs, using the same discharge coefficient of 3.8, which is considered reasonable. In addition, determinations of the drainage area made from recent USGS mapping indicate that the actual drainage area is only 2.24 square miles, which is about 14 percent smaller than the previous estimate.

b. Experience Data. An 8-foot high dam that once existed at the site failed during the August 1955 flood, apparently as a result of overtopping. The breached section was reported to be 50 feet wide, with scouring of the foundation to a depth of 8 feet. The records contain no mention of downstream damage. For the dam that was constructed in 1956, there are no records of maximum pool levels.

c. Visual Observations.

(1) General. The visual inspection of Wildwood Lake Dam, which is described in Section 3, resulted in a number of observations relevant to hydrology and hydraulics. These observations are evaluated herein for the various features.

(2) Embankment. The top of the embankment is lower than its design elevation over most of its length. The lowest point is at Elevation 1362.6, which is 0.9 foot lower than the design level. Accordingly, the existing spillway capacity is less than its maximum capacity.

(3) Appurtenant Structures. No deficiencies relevant to hydraulics were observed at the spillway or at the spillway exit channel. The supports for the spillway bridge have the potential to collect debris, which could reduce the spillway capacity.

The operating mechanism for the outlet works is damaged but still functional. The mechanism is located just above normal pool level, and could not be operated during periods of high pool levels. Furthermore, the reliability of the current method used in opening the valve is questionable.

(4) Reservoir Area. The development that has occurred within the watershed area to date does not significantly affect the hydrology. The 10-foot high unnamed dam located 0.7 mile upstream does have some effect on flood flows at Wildwood Lake Dam, and it was considered in the analysis described hereafter. If the dam were to fail under low flow conditions, it would not cause overtopping of Wildwood Lake Dam. If it failed at a time when Wildwood Lake was at its maximum pool level, it could cause overtopping and possibly failure of Wildwood Lake Dam.

(5) Downstream Conditions. No conditions were observed downstream from the dam that would reduce the spillway discharge capacity. If Wildwood Lake Dam were to fail under low flow conditions, it would not cause overtopping of Roamingwoods Lake Dam. If it failed at a time when Roamingwoods Lake was at its maximum pool level, it could cause overtopping and possibly failure of Roamingwoods Lake Dam. Since the Phase I Inspection Report for Roamingwoods Lake Dam indicates that it is a high hazard dam and since failure of Wildwood Lake Dam could under certain conditions cause overtopping and possibly failure of Roamingwoods Lake Dam, a high hazard classification is warranted for Wildwood Lake Dam.

d. Overtopping Potential.

(1) Spillway Design Flood. According to the criteria established by the Office of the Chief of Engineers (OCE), the Spillway Design Flood (SDF) for the size (Small) and hazard potential (High) of Wildwood Lake Dam is between one-half of the Probable Maximum Flood (PMF) and the PMF. Because of the magnitude of the damage that could result if failure of Wildwood Lake Dam were to cause failure of Roamingwoods Lake Dam, the PMF is selected as the SDF for Wildwood Lake Dam. The watershed was modeled with the U.S. Army Corps of Engineers' HEC-1DB computer program. A description of the model is included in Appendix D. The assessment of hydrology and hydraulics is based on existing conditions, and the effects of future development are not considered.

(2) Summary of Results. Pertinent results are tabulated at the end of Appendix D. The analysis for existing conditions shows that Wildwood Lake Dam can pass about 48 percent of the PMF without overtopping. During the 1/2 PMF, the depth and duration of overtopping would be 0.15 foot for 1.25 hours.

It is judged that this depth and duration would not cause overtopping failure. If the top of the dam was restored to its design elevation, the dam would pass about 62 percent of the PMF without any overtopping. For both conditions, failure of the unnamed dam located 0.7 mile upstream was not considered. It is estimated that the upstream dam can pass less than 5 percent of the PMF without overtopping. During the 1/2 PMF, that dam would be overtopped by 2.06 feet for 18.75 hours. It is judged that the upstream dam would fail during the 1/2 PMF, and would probably fail during floods smaller than the 1/2 PMF. Under certain conditions, failure of the upstream dam could result in failure of Wildwood Lake Dam during floods smaller than those Wildwood Lake Dam could normally withstand.

(3) Spillway Adequacy. The criteria used to rate the spillway adequacy of a dam are described in Appendix D. Since the depth and duration of overtopping that would occur during the 1/2 PMF are judged not to result in overtopping failure of Wildwood Lake Dam (without considering failure of the upstream dam), the spillway capacity is rated as inadequate under existing conditions. If the top of the dam were restored to its design elevation, the potential for overtopping would be greatly reduced; but the spillway capacity would still be rated as inadequate.

SECTION 6

STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability.

a. Visual Observations.

(1) General. The visual inspection of Wildwood Lake Dam, which is described in Section 3, resulted in a number of observations relevant to structural stability. These observations are evaluated herein for the various features.

(2) Embankment. The growth of brush and trees on the embankment slopes will eventually create a potential hazard to the dam. As the trees grow, the root systems create potential paths along which seepage can develop. In addition, the root systems can loosen the slope protection, and, if a tree should blow over, could cause damage to the embankment.

(3) Appurtenant Structures. The minor deterioration and cracking of the concrete in the spillway approach channel is a maintenance problem and does not yet constitute a hazard to the dam. The deterioration and leakage along the chute joints and on the apron are of more concern because there is no underlying filter or drainage layer. If conditions should worsen, loss of foundation soil might occur, which would create a hazard to the stability of the spillway.

The outlet conduit is in good condition. To ensure reliability of the valve operating mechanism under all conditions, the working platform should be raised and the mechanism should be extended and repaired. The alignment of the outlet channel is such that an erosion hazard might exist along the toe of the embankment if the conduit discharged at full capacity for a prolonged period of time.

b. Design and Construction Data. It appears that no stability analyses were performed during the design of the 1956 reconstruction. However, the existing slopes of the embankment are within the range normally used on dams of this height, and there were no indications of stability problems at the time of the inspection. As a result, the stability of the embankment is probably adequate provided that reasonable care was used during construction. There are no construction data for the dam. Other aspects concerning the design that are relevant to stability are discussed in Paragraph 2.1c.

c. Operating Records. There are no formal records of operation. According to available records, no stability problems have occurred since it was reconstructed in 1956.

d. Post-construction Changes. There have been no post-construction changes to the dam.

e. Seismic Stability. Wildwood Lake Dam is located in Seismic Zone 1. Normally, it can be considered that if a dam in this zone has adequate factors of safety under static loading conditions, it can be assumed safe for any expected earthquake loading. Since the factors of safety are assumed to be adequate, the dam is also assumed to be stable for any expected earthquake loading.

SECTION 7

ASSESSMENT, RECOMMENDATIONS, AND

PROPOSED REMEDIAL MEASURES

7.1 Dam Assessment

a. Safety.

(1) Based on available records, visual inspection, calculations, and past operational performance, Wildwood Lake Dam is judged to be in fair condition. Based on the size and hazard classification of the dam, the recommended SDF varies between the 1/2 PMF and the PMF. The selected SDF at the dam is the PMF. Based on existing conditions, the spillway will pass about 48 percent of the PMF without overtopping of the dam. It is judged that Wildwood Lake Dam could withstand the depth and duration of overtopping that would occur during the 1/2 PMF. As a result, the spillway capacity is rated as inadequate. If the low areas on the top of the dam were restored to the design elevation, the spillway would pass about 62 percent of the PMF without any overtopping. Restoring the dam to its design elevation would substantially reduce the risk of overtopping, but the spillway capacity would still be rated as inadequate. The results described above were obtained without considering failure of the unnamed dam located 0.7 mile upstream. It is judged that the upstream dam could fail by overtopping during floods smaller than the 1/2 PMF and that such failure could under certain conditions cause overtopping and failure of Wildwood Lake Dam during floods smaller than those Wildwood Lake Dam could normally withstand.

(2) No immediate stability problems were evident at the time of the inspection, but deficiencies do exist that could eventually affect the stability of the dam and appurtenances.

(3) Maintenance of the dam is considered inadequate.

(4) A summary of the features and observed deficiencies is listed below:

Feature and Location	Observed Deficiency
Embankment:	Low areas on top; brush and trees on both slopes.

Feature and Location	Observed Deficiency
Spillway:	Minor deterioration and cracking of approach channel concrete; deterioration along chute joints and on apron; bridge supports in approach channel.
Outlet Works:	No access during high pool levels; operating mechanism damaged; poor alignment of outlet channel.

b. Adequacy of Information. The information available is such that an assessment of the condition of the dam can be inferred from the combination of visual inspection, past performance, and computations performed prior to and as part of this study.

c. Urgency. The recommendations in Paragraph 7.2 should be implemented without delay.

d. Necessity for Further Investigations. Accomplishment of the remedial measures outlined in Paragraph 7.2, will require further investigations by the Owner.

7.2 Recommendations and Remedial Measures.

a. The following remedial measures are recommended to be undertaken by the Owner, in approximate order of priority, without delay:

(1) Fill all low areas on the top of the dam to the design elevation of 1363.5.

(2) Provide equipment as required for removal of debris that might collect on the spillway bridge supports during floods.

(3) Remove all brush and trees from the slopes of the embankment.

(4) Make modifications as required to ensure access to the valve operating mechanism under all conditions and restore the mechanism to its full operating condition.

(5) Visually monitor the condition of the chute joints and the concrete and stone apron. If conditions worsen, design and construct remedial measures.

(6) Provide a means for preventing erosion at the toe of the dam in the event of prolonged outlet works discharge.

All designs, and inspection of construction should be performed by a professional engineer experienced in the design and construction of dams.

b. In addition, the Owner should institute the following operational and maintenance procedures:

(1) Develop a detailed emergency operation and warning system for Wildwood Lake Dam. When warnings of a storm of major proportions are given by the National Weather Service, the Owner should activate his emergency operation and warning system.

(2) During periods of unusually heavy rains, provide round-the-clock surveillance of Wildwood Lake Dam.

(3) As presently required by the Commonwealth, institute a program of formal annual inspections by a professional engineer experienced in the design and construction of dams. Utilize the inspection results to determine if remedial measures are necessary.

(4) Expand the existing maintenance program and develop a formal maintenance manual so that all features of the dam are properly maintained.

APPENDIX A

CHECKLIST - ENGINEERING DATA

CHECKLIST

ENGINEERING DATA

DESIGN, CONSTRUCTION, AND OPERATION
PHASE I

NAME OF DAM: Wildwood Lake Dam

NDI ID NO.: PA-00157 DER ID NO.: 64-30

Sheet 1 of 4

ITEM	REMARKS
AS-BUILT DRAWINGS	None for original dam. Full set of design drawings for 1956 reconstruction. See Plates E-2 and E-3 in Appendix E.
REGIONAL VICINITY MAP	See Location Map, Plate E-1.
CONSTRUCTION HISTORY	Original dam constructed prior to 1917; dam failed August 1955; new dam constructed at site 1956. No modifications since 1956.
TYPICAL SECTIONS OF DAM	See Plate E-3 in Appendix E.
OUTLETS: Plan Details Constraints Discharge Ratings	See Plates E-2 and E-3 in Appendix E.

ENGINEERING DATA

ITEM	REMARKS
RAINFALL/RESERVOIR RECORDS	None available.
DESIGN REPORTS	Permit application report for reconstruction prepared by Commonwealth in 1955 describes design.
GEOLOGY REPORTS	None.
DESIGN COMPUTATIONS: Hydrology and Hydraulics Dam Stability Seepage Studies	None. In 1955, Commonwealth recommended that spillway capacity should be at least 1,950 cfs.
MATERIALS INVESTIGATIONS: Boring Records Laboratory Field	None.
POSTCONSTRUCTION SURVEYS OF DAM	None.

ENGINEERING DATA

ITEM	REMARKS
BORROW SOURCES	Unknown.
MONITORING SYSTEMS	None.
MODIFICATIONS	None since 1956 reconstruction.
HIGH POOL RECORDS	None.
POSTCONSTRUCTION ENGINEERING STUDIES AND REPORTS	None.
PRIOR ACCIDENTS OR FAILURE OF DAM: Description Reports	Dam failed during flood of August 17-18, 1955. Apparently overtopping failure. Breach was 50' wide and located left of spillway. No reports of downstream damage.

ENGINEERING DATA

ITEM	REMARKS
MAINTENANCE AND OPERATION RECORDS	Periodic correspondence describing type and extent of maintenance.
SPILLWAY: Plan Sections Details	See Plate E-2 in Appendix E.
OPERATING EQUIPMENT: Plans Details	None.
PREVIOUS INSPECTIONS Dates Deficiencies	1960: Leak at downstream toe near outlet conduit (was also reported by Owner in 1957) 1965: Gate leaking slightly. Note: Numerous inspections were made between 1917 and 1952. They are not relevant because a new dam was constructed in 1956.

APPENDIX B

CHECKLIST - VISUAL INSPECTION

CHECKLIST

VISUAL INSPECTION

PHASE I

Name of Dam: Wildwood Lake Dam County: Wayne State: Pennsylvania

NDI ID No.: PA-00157 DER ID No.: 64-30

Type of Dam: Earth fill Hazard Category: High

Date(s) Inspection: 12 November 1980 Weather: Windy; overcast Temperature: 30°F

Pool Elevation at Time of Inspection: 1358.0 msl/Tailwater at Time of Inspection: 1345.2 msl

Pool at spillway crest level on date of inspection.

Inspection Personnel:

D. B. Wilson (GFCC)	G. Teets (Member, Wildwood Park Outing Club, Inc.)	
R. E. Halderbaum (GFCC)	I. Gant (Caretaker)	
D. R. Ebersole (GFCC)		

D. B. Wilson Recorder

DB-1

EMBANKMENT

Sheet 1 of 2

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None apparent.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None.	
SLOUGHING OR EROSION: Embankment Slopes Abutment Slopes	None.	
CREST ALIGNMENT: Vertical Horizontal	See profile of dam, Sheet B-9.	
RIPRAP FAILURES	None. Riprap on upstream slope in good condition except for brush and trees.	

EMBANKMENT

Sheet 2 of 2

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT WITH: Abutment Spillway Other Features	Abutments - no deficiencies. Spillway - low areas as shown on profile on Sheet B-9.	
ANY NOTICEABLE SEEPAGE	None.	
STAFF GAGE AND RECORDER	None.	
DRAINS	None apparent.	
TREES AND BRUSH	Upstream and downstream slopes covered with brush and many trees.	Average size of trees 3"- 4" diameter. Maximum size about 8" diameter.

UNGATED SPILLWAY

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	Triangular concrete weir with steel crest angle. Fair condition.	
APPROACH CHANNEL	Concrete-lined approach channel from reservoir. No debris.	Right approach wall deteriorated at upstream end. One crack in left approach wall. Neither condition serious.
DISCHARGE CHANNEL	Steep conc. chute with conc. and stone apron Some deterioration along joints and on apron. Slight leakage from deteriorated areas.	No drains for chute slab.
BRIDGE AND PIERS	Footbridge with 3 piers in approach channel about 8' upstream from weir.	Low steel of bridge is at design level of top of dam. No debris at bridge piers.

OUTLET WORKS

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	24" dia. concrete pipe. Good condition. No leakage into conduit.	
INTAKE STRUCTURE	Submerged - not visible.	
OUTLET STRUCTURE	Small concrete structure at downstream toe of dam. No deficiencies.	
OUTLET CHANNEL	No well-defined outlet channel. Eventually would flow into stream channel approx. 100' away.	Maximum discharge for prolonged period could cause erosion near downstream toe of dam.
EMERGENCY GATE	Gate valve at upstream end of conduit. No leakage.	Originally operated with stem and handwheel. Was damaged and now requires jack to open. Opened last year.

INSTRUMENTATION

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None.	
OBSERVATION WELLS	None.	
WEIRS	None.	
PIEZOMETERS	None.	
OTHER	None.	

RESERVOIR AND WATERSHED

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Generally mild and wooded. No indications of instability.	
SEDIMENTATION	None reported.	
WATERSHED DESCRIPTION	Approx. 90% wooded; partially developed.	Unnamed dam (10' high) located just upstream. No DER I.D. No. assigned.

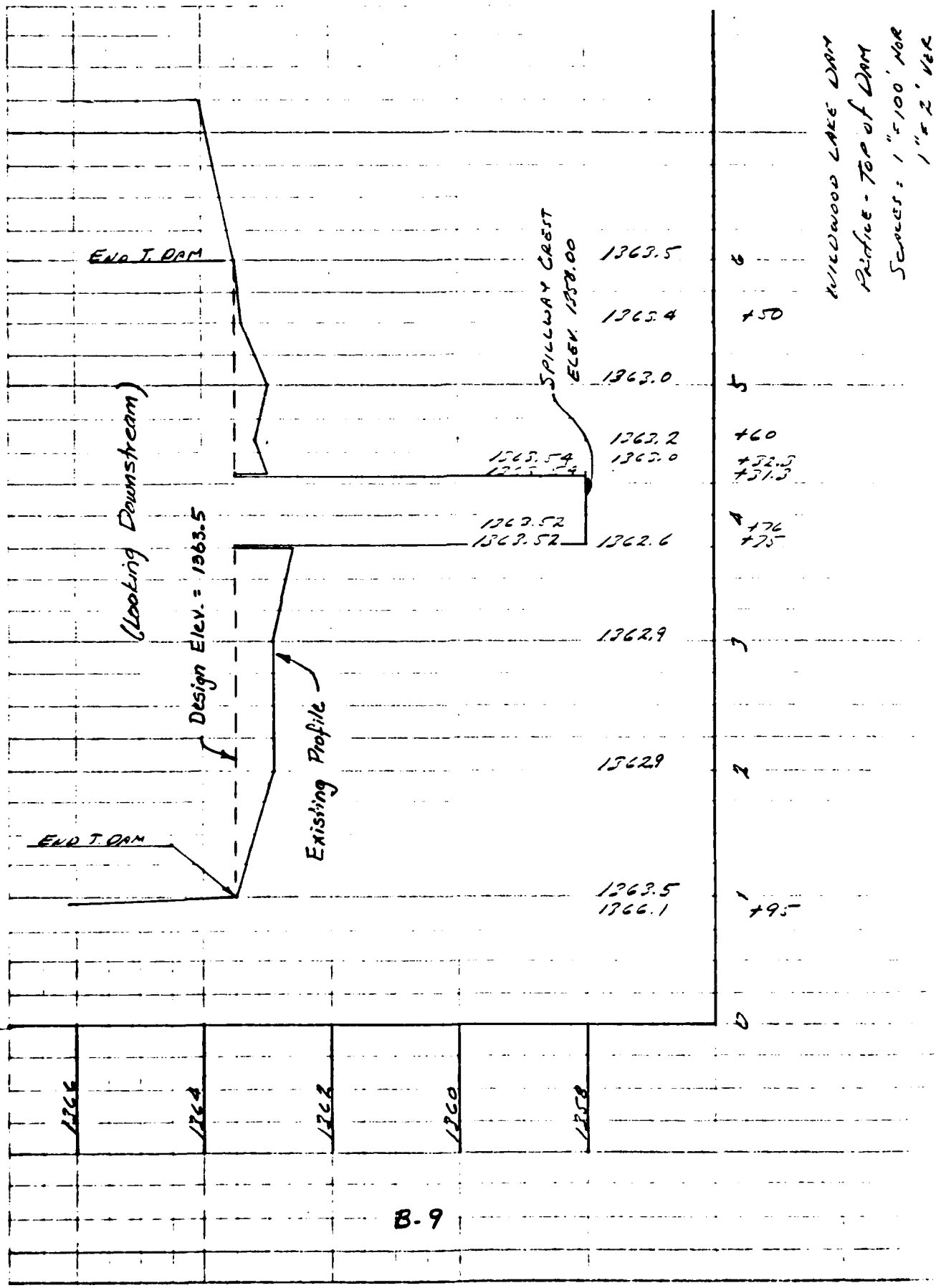
DOWNSTREAM CHANNEL

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION: Obstructions Debris Other	Wooded valley with moderate slope. No significant obstructions.	
SLOPES	Wooded. No indications of instability.	
APPROXIMATE NUMBER OF HOMES AND POPULATION	Roamingwoods Lake located approx. 1000' downstream.	Roamingwoods Lake Dam (PA-00166; 64-191) classified as high hazard dam. Inspected June 1978.

BY _____ DATE _____ SUBJECT Wildwood Lake Dam — Profile Top of Dam — SHEET NO _____ OF _____

CHKD BY _____ DATE _____ JOB NO _____

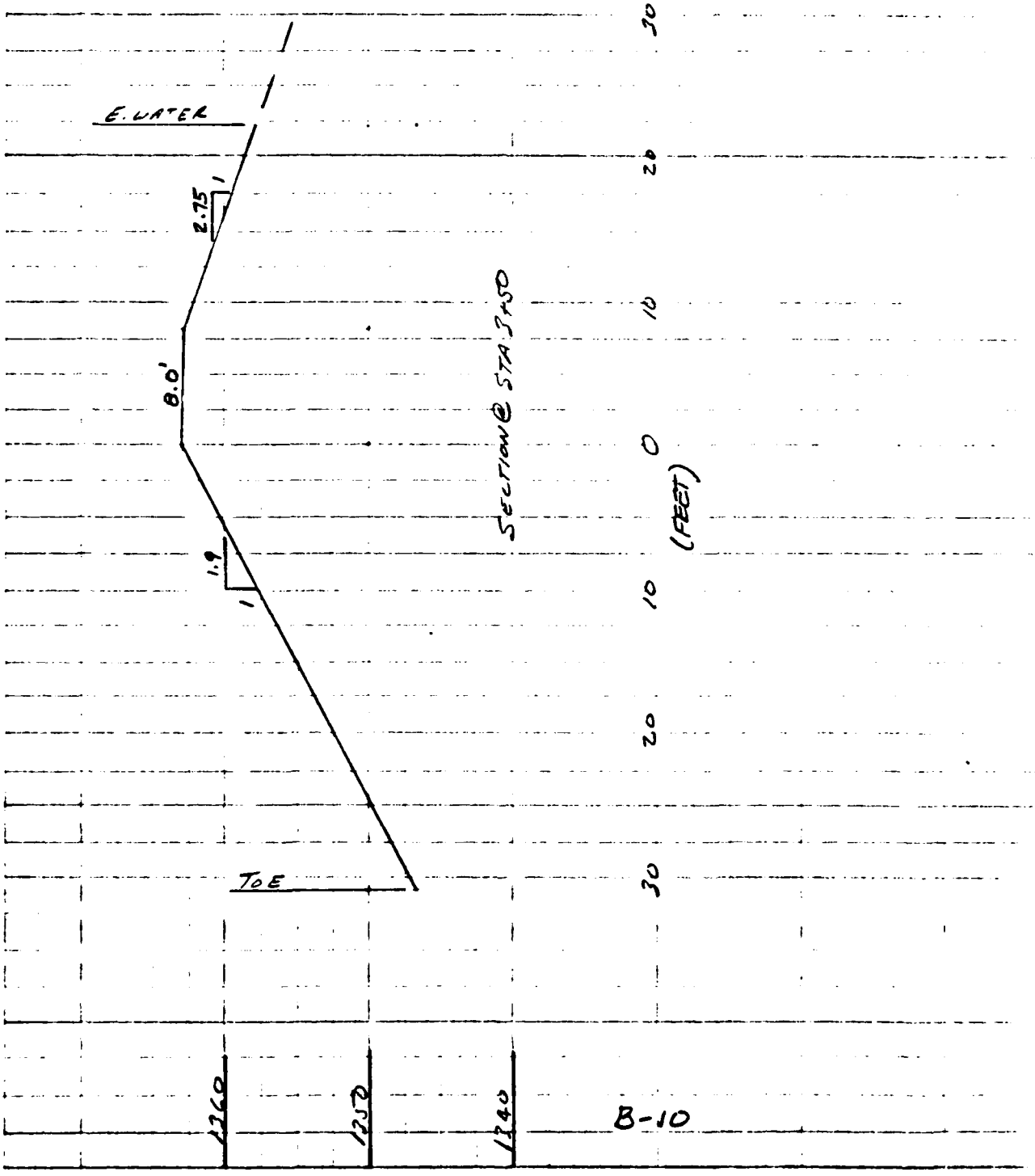


BY _____ DATE _____ SUBJECT Wilander Lake Dam

CHKD BY _____ DATE _____ Section on Embankment

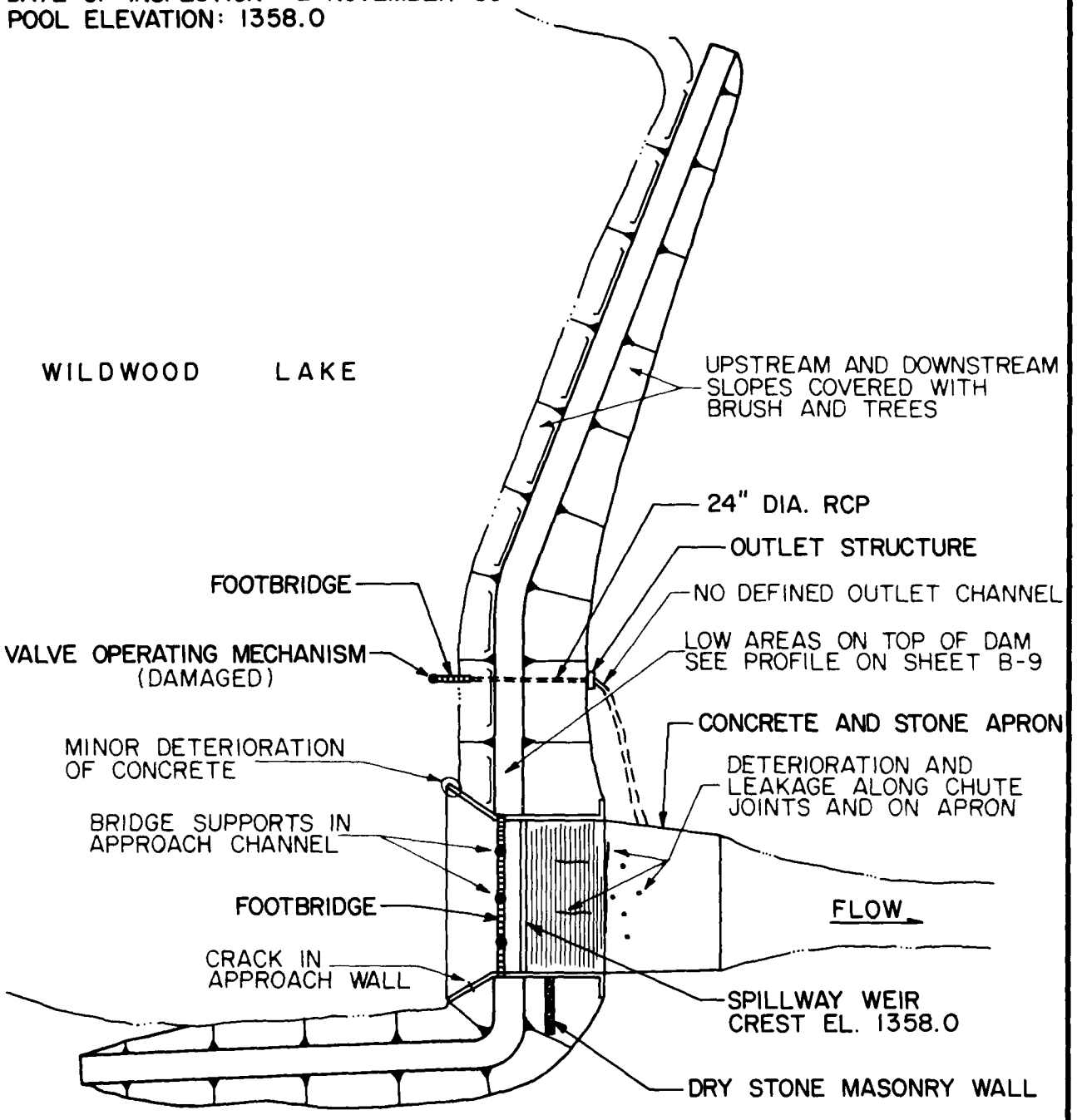
SHEET NO _____ OF _____

JOB NO _____



B-10

DATE OF INSPECTION: 12 NOVEMBER 80
POOL ELEVATION: 1358.0



NOT TO SCALE

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

WILDWOOD LAKE DAM

WILDWOOD PARK OUTING CLUB, INC.

RESULTS OF VISUAL INSPECTION

MARCH 1981 EXHIBIT B-1

APPENDIX C

PHOTOGRAPHS

A. Top of Dam

B. Upstream Slope Near Left Abutment

C. Spillway and Embankment

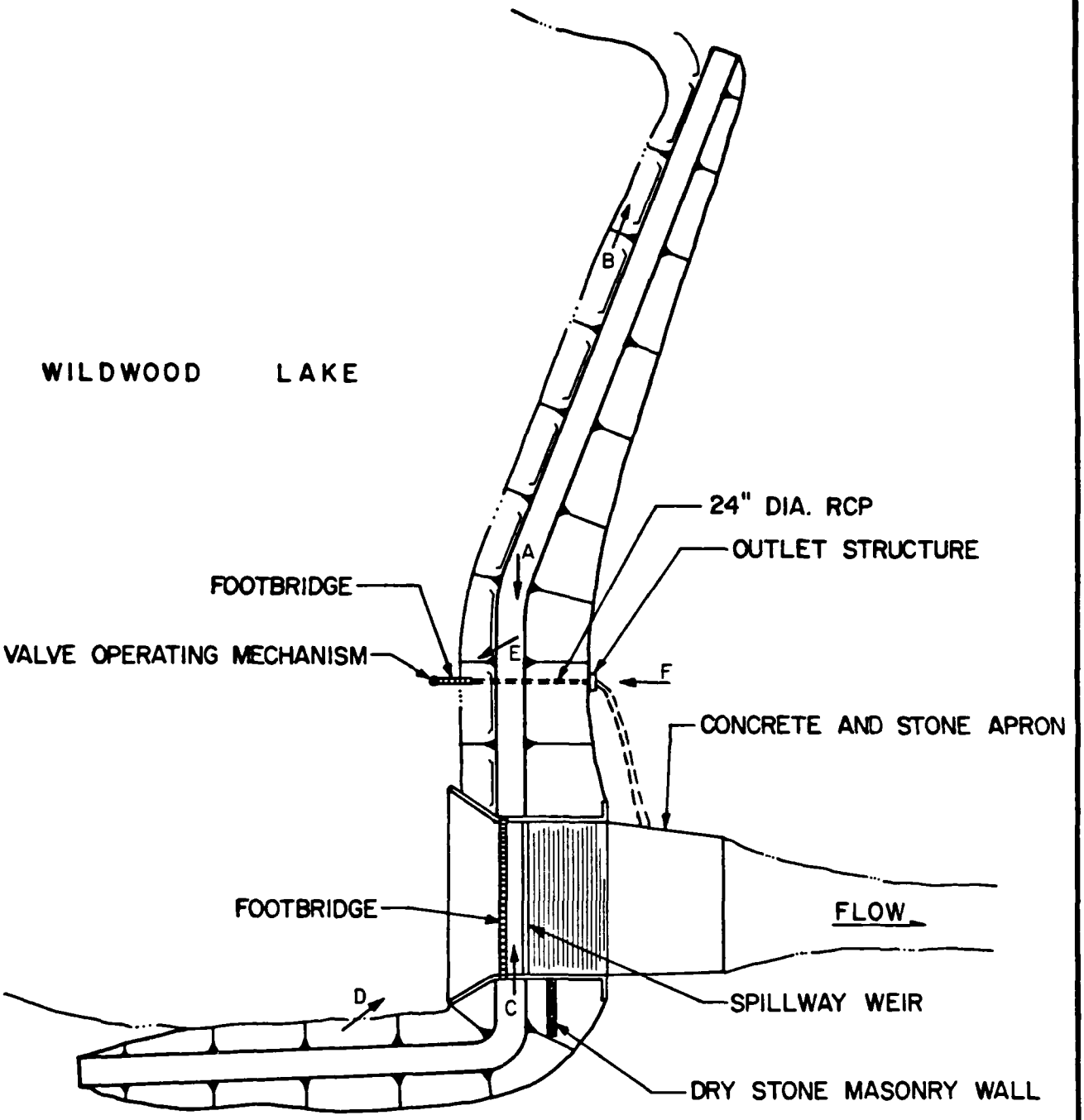
D. Spillway Approach Channel

E. Bridge to Valve Operating Mechanism

F. Downstream End Outlet Conduit

G. Unnamed Dam 0.7 Mile Upstream

H. Roamingwoods Lake Dam Located 1.4 Miles Downstream



NOT TO SCALE

← LOCATION AND ORIENTATION OF CAMERA

A PHOTOGRAPH IDENTIFICATION LETTER

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

WILDWOOD LAKE DAM

WILDWOOD PARK OUTING CLUB, INC.

GUIDE TO LOCATION OF PHOTOGRAPHS

MARCH 1981 EXHIBIT C-1

APPENDIX D

HYDROLOGY AND HYDRAULICS

APPENDIX D

HYDROLOGY AND HYDRAULICS

Spillway Capacity Rating:

In the recommended Guidelines for Safety Inspection of Dams, the Department of the Army, Office of the Chief of Engineers (OCE), established criteria for rating the capacity of spillways. The recommended Spillway Design Flood (SDF) for the size (small, intermediate, or large) and hazard potential (low, significant, or high) classification of a dam is selected in accordance with the criteria. The SDF for those dams in the high hazard category varies between one-half of the Probable Maximum Flood (PMF) and the PMF. If the dam and spillway are not capable of passing the SDF without overtopping failure, the spillway capacity is rated as inadequate. If the dam and spillway are capable of passing one-half of the PMF without overtopping failure, or if the dam is not in the high hazard category, the spillway capacity is not rated as seriously inadequate. A spillway capacity is rated as seriously inadequate if all of the following conditions exist:

(a) There is a high hazard to loss of life from large flows downstream of the dam.

(b) Dam failure resulting from overtopping would significantly increase the hazard to loss of life downstream from the dam from that which would exist just before overtopping failure.

(c) The dam and spillway are not capable of passing one-half of the PMF without overtopping failure.

Description of Model:

If the Owner has not developed a PMF for the dam, the watershed is modeled with the HEC-1DB computer program, which was developed by the U.S. Army Corps of Engineers. The HEC-1DB computer program calculates a PMF runoff hydrograph (and percentages thereof) and routes the flows through both reservoirs and stream sections. In addition, it has the capability to simulate an overtopping dam failure. By modifying the rainfall criteria, it is also possible to model the 100-year flood with the program.

APPENDIX D

Delaware River Basin
Name of Stream: Ariel Creek
Name of Dam: Wildwood Lake Dam
NDI ID No.: PA-00157
DER ID No.: 64-30
Latitude: N 41° 26' 35" Longitude: W 75° 20' 50"
Top of Dam Elevation: 1362.6 (Low Point)
Streambed Elevation: 1345.0 Height of Dam: 17.6 ft
Reservoir Storage at Top of Dam Elevation: 644 acre-ft
Size Category: Small
Hazard Category: High (see Section 5)
Spillway Design Flood: Recommended SDF varies from ½ PMF to PMF; Select PMF based on downstream conditions

UPSTREAM DAMS

Name	Distance from Dam (miles)	Height (ft)	Storage at top of Dam Elevation (acre-ft)	Remarks
Unnamed Dam	0.7	10	99	Not listed by Penn DER

DOWNSTREAM DAMS

Roamingwoods Lake Dam	1.4	32	3,965	NDI PA-00166 DER No. 64-191
Wallenpaupack Dam	10	66	215,000	DER No. 52-51

Delaware River Basin

Name of Stream: Ariel Creek

Name of Dam: Wildwood Lake Dam

DETERMINATION OF PMF RAINFALL & UNIT HYDROGRAPH

UNIT HYDROGRAPH DATA:

Sub-area	Drainage Area (square miles)	Cp (1)	Ct (2)	L miles (3)	L_{ca} miles (4)	L' miles (5)	Tp hours (6)	Map Area (7)	Plate (8)
A-1	1.58	0.45	1.23	1.86	0.44	—	1.16	1	A
A-2	0.66	0.45	1.23	—	—	0.63	0.93	1	A
Total	2.24								

(See Sketch on Sheet D-4)

(1) & (2): Snyder Unit Hydrograph coefficients supplied by Baltimore District, Corps of Engineers on maps and plates referenced in (7) & (8)

The following are measured from the outlet of the subarea:

(3): Length of main watercourse extended to divide

(4): Length of main watercourse to the centroid

The following is measured from the upstream end of the reservoir at normal pool:

(5): Length of main watercourse extended to divide

(6): $Tp=C_t \times (L \times L_{ca})^{0.3}$, except where the centroid of the subarea is located in the reservoir. Then $Tp=C_t \times (L')^{0.6}$

Initial flow is assumed at 1.5 cfs/sq. mile

Computer Data: QRCSN = -0.05 (5% of peak flow)
RTIOR = 2.0

RAINFALL DATA:

PMF Rainfall Index= 21.5 in., 24 hr., 200 sq. mile

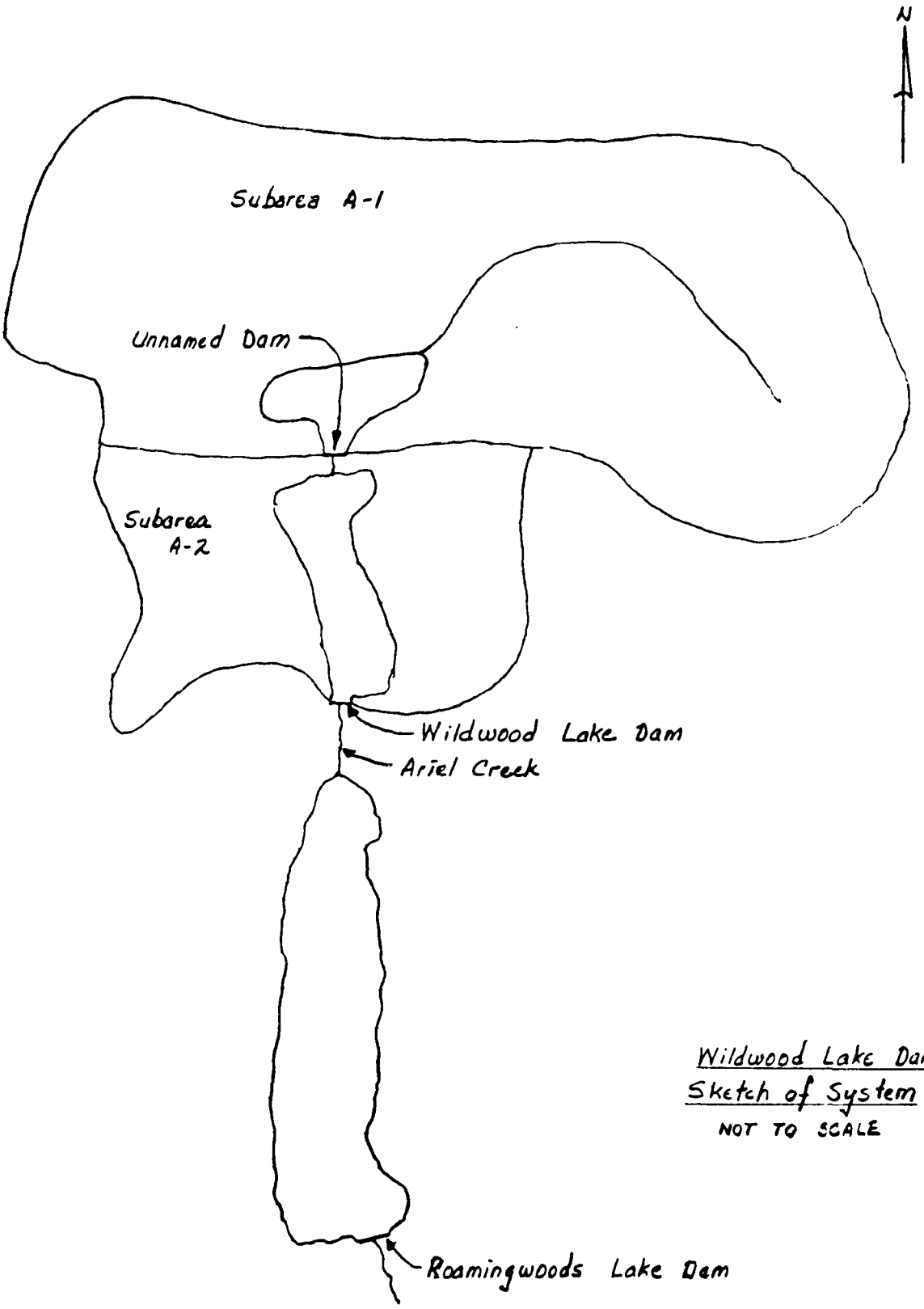
	Hydromet. 40 (Susquehanna Basin)	Hydromet. 33 (Other Basins)
Zone:	N/A	1
Geographic Adjustment Factor:	N/A	1.0
Revised Index Rainfall:	N/A	21.5

RAINFALL DISTRIBUTION (percent)

Time	Percent
6 hours	111
12 hours	123
24 hours	133
48 hours	142
72 hours	N/A
96 hours	N/A

BY _____ DATE _____ SUBJECT _____ SHEET NO _____ OF _____

CHKD BY _____ DATE _____ JOB NO _____



Wildwood Lake Dam
Sketch of System
NOT TO SCALE

Data for Dam at Outlet of Subarea A-1 (See sketch on Sheet D-4)

Name of Dam: Unnamed Dam 0.7 Mile Upstream

STORAGE DATA:

Elevation	Area (acres)	Storage million gals	Storage acre-ft	Remarks
1362.0 =ELEVO	0	0	0 *	Streambed
1370.5 =ELEV1	22 =A1	20	62 =S1*	Normal pool
1372.0	27	32	99	Top of dam
1380.0	63	146	449	

* $S1 = \frac{A1(ELEV1 - ELEV0)}{3}$

** Planimetered contour ~~at least 10 feet~~ above top of dam

Reservoir Area at Normal Pool is 2 percent of subarea watershed.

BREACH DATA: Dam assumed not to fail for analysis of Wildwood Lake Dam

See Appendix B for sections and existing profile of the dam.

Soil Type from Visual Inspection: _____

Maximum Permissible Velocity (Plate 28, EM 1110-2-1601) _____ fps
(from $Q = CLH^{3/2} = V \cdot A$ and depth = (2/3) x H) & A = L·depth

HMAX = $(4/9\ V^2/C^2)$ = _____ ft., C = ____ Top of Dam El.= ____

HMAX + Top of Dam El. = _____ = FAILEL
(Above is elevation at which failure would start)

Dam Breach Data:

BRWID = _____ ft (width of bottom of breach)
Z = _____ (side slopes of breach)
ELBM = _____ (bottom of breach elevation, minimum of zero storage elevation)
WSEL = _____ (normal pool elevation)
T FAIL= _____ mins = _____ hrs (time for breach to develop)

Data for Dam at Outlet of Subarea A-1

Name of Dam: Unnamed Dam 0.7 Mile Upstream

SPILLWAY DATA:	Existing Conditions	Design Conditions
Top of Dam Elevation	1372.0	
Spillway Crest Elevation	1370.5	
Spillway Head Available (ft)	1.5	
Type Spillway	Concrete weir	
"C" Value - Spillway	2.9	
Crest Length - Spillway (ft)	10	
Spillway Peak Discharge (cfs)	53	
Auxiliary Spillway Crest Elev.	N/A	
Auxiliary Spill. Head Avail. (ft)	N/A	
Type Auxiliary Spillway	N/A	
"C" Value - Auxiliary Spill. (ft)	N/A	
Crest Length - Auxil. Spill. (ft)	N/A	
Auxiliary Spillway Peak Discharge (cfs)	N/A	
Combined Spillway Discharge (cfs)	53	

Not Applicable

Spillway Rating Curve: $Q = (2.9)(10)H^{1.5}$

Elevation	Q Spillway (cfs)	Q Auxiliary Spillway (cfs)	Combined (cfs)

OUTLET WORKS RATING:	Outlet 1	Outlet 2	Outlet 3
Invert of Outlet			
Invert of Inlet			
Type			
Diameter (ft) = D			
Length (ft) = L			
Area (sq. ft) = A			
N			
K Entrance			
K Exit			
K Friction=$29.1_N{}^2L/R^{4/3}$			
Sum of K			
$(1/K)^{0.5}$ = C			
Maximum Head (ft) = HM			
$Q = CA\sqrt{2g(HM)}$ (cfs)			
Q Combined (cfs)			

Not Applicable

Data for Dam at Outlet of Subarea A-2 (See sketch on Sheet D-4)

Name of Dam: Wildwood Lake Dam

STORAGE DATA:

Elevation	Area (acres)	Storage million gals	Storage acre-ft	Remarks
1345.0 =ELEVO	0	0	0	Streambed
1358.0 =ELEV1	67 =A1	94	290 =S1*	Normal pool
1362.6	87	209	644	Low pt. top dam
1363.5	92	235	724	Design top dam
1380.0 **	188	969	2983	

* $S1 = \frac{A1(ELEV1 - ELEVO)}{3}$

** Planimetered contour at least 10 feet above top of dam

Reservoir Area at Normal Pool is 16 percent of subarea watershed.

BREACH DATA: Breach analysis not performed for Wildwood Lake Dam.

See Appendix B for sections and existing profile of the dam.

Soil Type from Visual Inspection: _____

Maximum Permissible Velocity (Plate 28, EM 1110-2-1601) _____ fps
(from $Q = CLH^{3/2} = V \cdot A$ and depth = (2/3) x H) & A = L·depth

HMAX = $(4/9\ V^2/C^2)$ = _____ ft., C = ____ Top of Dam El.= ____

HMAX + Top of Dam El. = _____ = FAILEL
(Above is elevation at which failure would start)

Dam Breach Data:

BRWID = _____ ft (width of bottom of breach)
Z = _____ (side slopes of breach)
ELBM = _____ (bottom of breach elevation, minimum of zero storage elevation)
WSEL = _____ (normal pool elevation)
T FAIL= _____ mins = _____ hrs (time for breach to develop)

Data for Dam at Outlet of Subarea A-2

Name of Dam: Wildwood Lake Dam

SPILLWAY DATA:	Existing Conditions	Design Conditions
Top of Dam Elevation	1362.6	1363.5
Spillway Crest Elevation	1358.0	1358.0
Spillway Head Available (ft)	4.6	5.5
Type Spillway	Triangular conc. weir	
"C" Value - Spillway	3.8	3.8
Crest Length - Spillway (ft)	55.3	55.3
Spillway Peak Discharge (cfs)	2073	2710
Auxiliary Spillway Crest Elev.	N/A	N/A
Auxiliary Spill. Head Avail. (ft)	N/A	N/A
Type Auxiliary Spillway	N/A	
"C" Value - Auxiliary Spill. (ft)	N/A	N/A
Crest Length - Auxil. Spill. (ft)	N/A	N/A
Auxiliary Spillway Peak Discharge (cfs)	N/A	N/A
Combined Spillway Discharge (cfs)	2073	2710

Spillway Rating Curve: $Q = (3.8)(55.3)(H)^{1.5}$

Elevation	Q Spillway (cfs)	Q Auxiliary Spillway (cfs)	Combined (cfs)

OUTLET WORKS RATING:	Outlet 1	Outlet 2	Outlet 3
Invert of Outlet	1349.5		
Invert of Inlet	1354.0		
Type	RCP		
Diameter (ft) = D	2		
Length (ft) = L	48		
Area (sq. ft) = A	3.14		
N	0.011		
K Entrance	0.5		
K Exit	1.0		
K Friction=$29.1 n^2 L/R^{4/3}$	0.4		
Sum of K	1.9		
$(1/K)^{0.5} = C$	0.7		
Maximum Head (ft) = HM	13		
$Q = CA\sqrt{2g(HM)}$ (cfs)	64		
Q Combined (cfs)	64		

BY _____ DATE _____ SUBJECT _____ SHEET NO _____ OF _____

CHKD BY _____ DATE _____ JOB NO _____

Index of Selected Computer Output

```
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION   01 APR 81
**********
    1                 A1                    NATIONAL DAM INSPECTION PROGRAM
    2                 A2                BALTIMORE DISTRICT CORPS OF ENGINEERS
    3                 A3                          WILDWOOD LAKE DAM
    4                 B    300       0       15       0       0       0       0       0      -4       0
    5                 P1     5
    6                 J      1       7       1
    7                 J1   1.0     0.9     0.8     0.7     0.6     0.5     0.4
    8                 K      0       1                                       1
    9                 K1       INFLOW TO UNNAMED POND 0.7 MILE UPSTREAM
   10                 M      1       1    1.58            2.24                                       1
   11                 P              21.5     111     123     133     142
   12                 T                                                      1.0    0.05             0.02
   13                 W   1.16    0.45
   14                 X   -1.5   -0.05     2.0
   15                 K      1       1                                       1
   16                 K1       ROUTE THROUGH UNNAMED POND
   17                 Y                                1       0
   18                 Y1     1                                       -1370.5
   19                 SA     0      22      27      63
   20                 SE1362.0  1370.5  1372.0  1380.0
   21                 SS1370.5      10     2.9     1.5
   22                 SD1372.0
   23                 SL   115     270     280     300     320
   24                 SV1372.0  1373.5  1374.0  1377.0  1380.0
   25                 K                2                                      1
   26                 K1       SUBAREA RUNOFF TO WILDWOOD LAKE
   27                 M      1       1    0.66            2.24                                       1
   28                 P              21.5     111     123     133     142
   29                 T                                                      1.0    0.05             0.16
   30                 W   0.93    0.45
   31                 X   -1.5   -0.05     2.0
   32                 K      2       2                                       1
   33                 K1       COMBINE HYDROGRAPHS
   34                 K      1       2                                       1
   35                 K1       ROUTE THROUGH WILDWOOD LAKE
   36                 Y                                1
   37                 Y1     1                                       -1358.0
   38                 SA     0      67      87      92     198
   39                 SE1365.0  1358.0  1362.6  1363.5  1380.0
   40                 SS1358.0    55.3     3.8     1.5
   41                 SD1362.6
   42                 SL     0      72     188     445     560     600
   43                 SV1362.6  1362.9  1363.0  1363.5  1364.0  1366.0
   44                 K     99
```

D-10

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 1.00	RATIO 2 .90	RATIO 3 .80	RATIO 4 .70	RATIO 5 .60	RATIO 6 .50	RATIO 7 .40
HYDROGRAPH AT	1	1.58	1	4076.	3668.	3261.	2853.	2446.	2038.	1630.
	(	4.09)	(	115.42)(	103.88)(	92.34)(	80.79)(	69.25)(	57.71)(	46.17)(
ROUTED TO	1	1.58	1	3988.	3585.	3183.	2780.	2378.	1976.	1571.
	(	4.09)	(	112.92)(	101.53)(	90.13)(	78.73)(	67.33)(	55.90)(	44.49)(
HYDROGRAPH AT	2	.66	1	1921.	1729.	1537.	1345.	1153.	961.	768.
	(	1.71)	(	54.40)(	48.96)(	43.52)(	38.08)(	32.64)(	27.20)(	21.76)(
2 COMBINED	2	2.24	1	5758.	5178.	4599.	4019.	3440.	2859.	2276.
	(	5.80)	(	163.04)(	146.63)(	130.23)(	113.81)(	97.40)(	80.96)(	64.45)(
ROUTED TO	2	2.24	1	5438.	4794.	4138.	3457.	2770.	2175.	1703.
	(	5.80)	(	153.97)(	135.74)(	117.18)(	97.90)(	78.44)(	61.59)(	48.23)(

SUMMARY OF DAM SAFETY ANALYSIS

Unnamed Dam 0.7 Mile Upstream

PLAN 1 ....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1370.50	1370.50	1372.00
STORAGE	62.	62.	99.
OUTFLOW	0.	0.	53.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1375.09	3.09	201.	3988.	23.75	41.00	0.00
.90	1374.90	2.90	193.	3585.	23.00	41.00	0.00
.80	1374.71	2.71	186.	3183.	22.50	41.00	0.00
.70	1374.51	2.51	179.	2780.	21.50	41.00	0.00
.60	1374.29	2.29	171.	2378.	20.25	41.00	0.00
.50	1374.06	2.06	163.	1974.	18.75	41.00	0.00
.40	1373.81	1.81	154.	1571.	16.75	41.25	0.00

SUMMARY OF DAM SAFETY ANALYSIS

Wildwood Lake Dam

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1358.00	1358.00	1362.60
STORAGE	290.	290.	644.
OUTFLOW	0.	0.	2073.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1364.34	1.74	803.	5438.	5.00	41.50	0.00
.90	1364.14	1.54	786.	4794.	4.75	41.50	0.00
.80	1363.93	1.33	764.	4138.	4.25	41.75	0.00
.70	1363.66	1.06	739.	3457.	3.75	42.00	0.00
.60	1363.31	.71	706.	2770.	3.00	42.25	0.00
.50	1362.75	.15	656.	2175.	1.25	42.50	0.00
.40	1362.03	0.00	595.	1703.	0.00	42.50	0.00

BY _____ DATE _____ SUBJECT _____ SHEET NO _____ OF _____

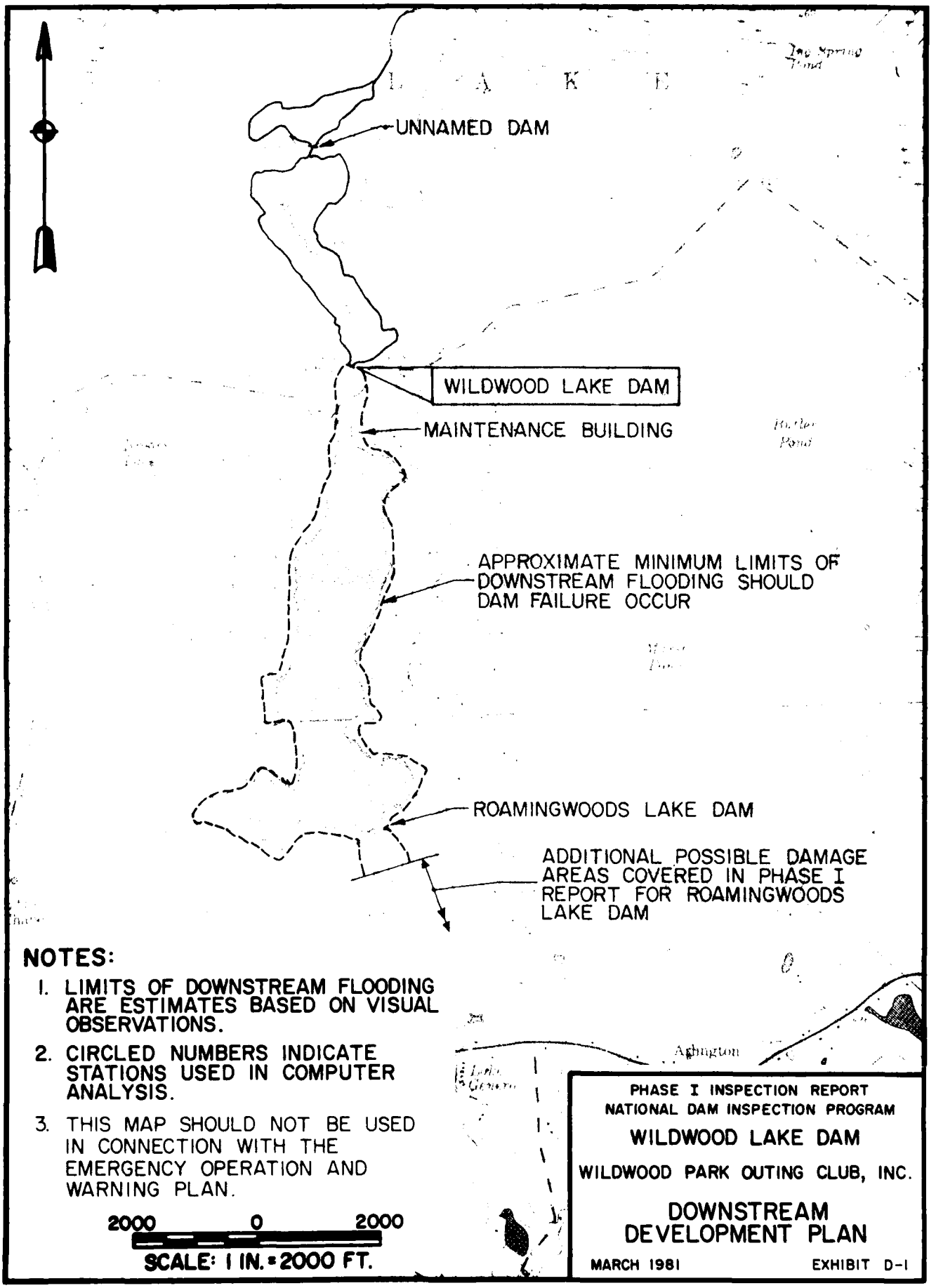
CHKD BY _____ DATE _____ JOB NO _____

Wildwood Lake Dam

Summary of Pertinent Results

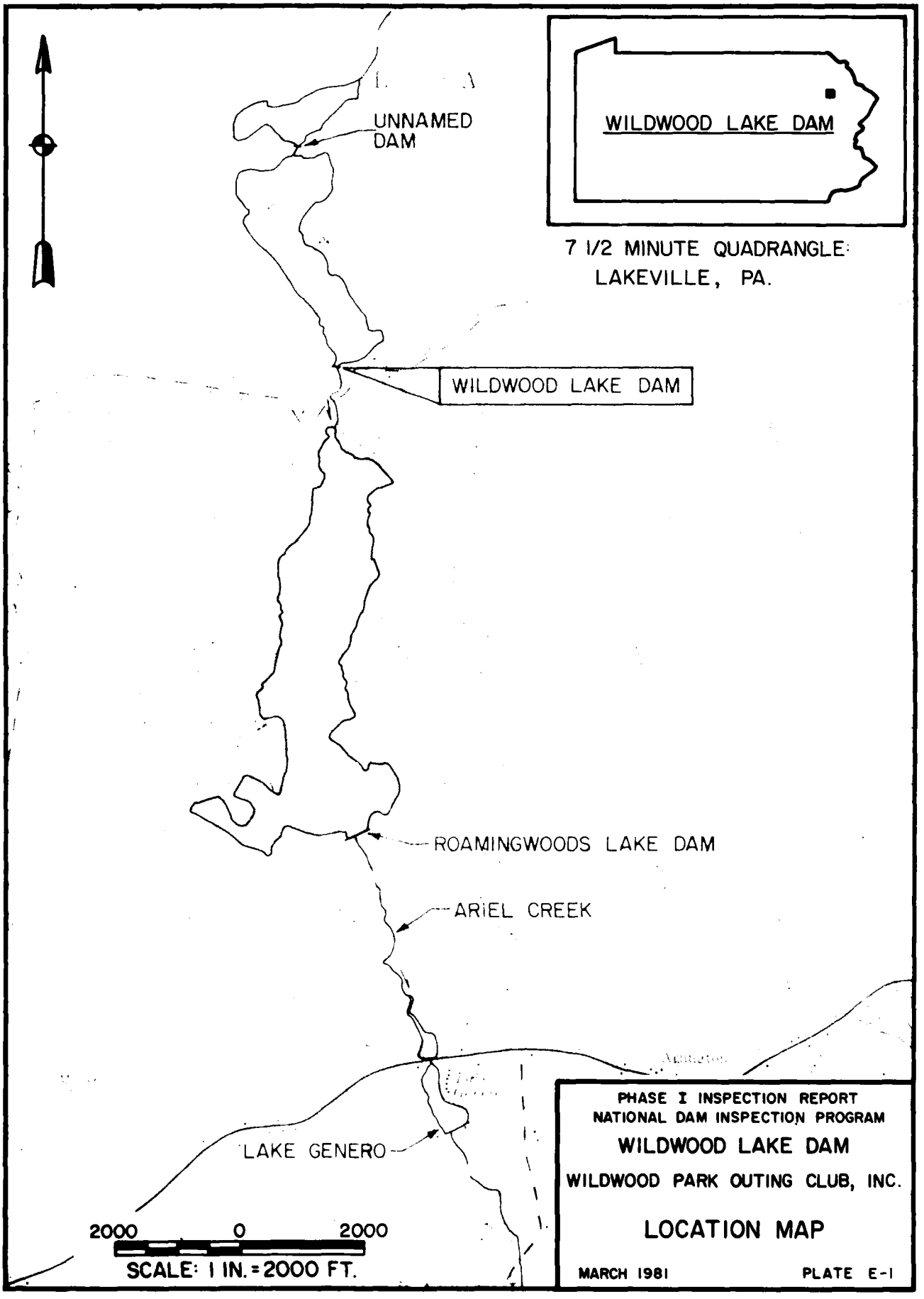
Multi-ratio Analysis

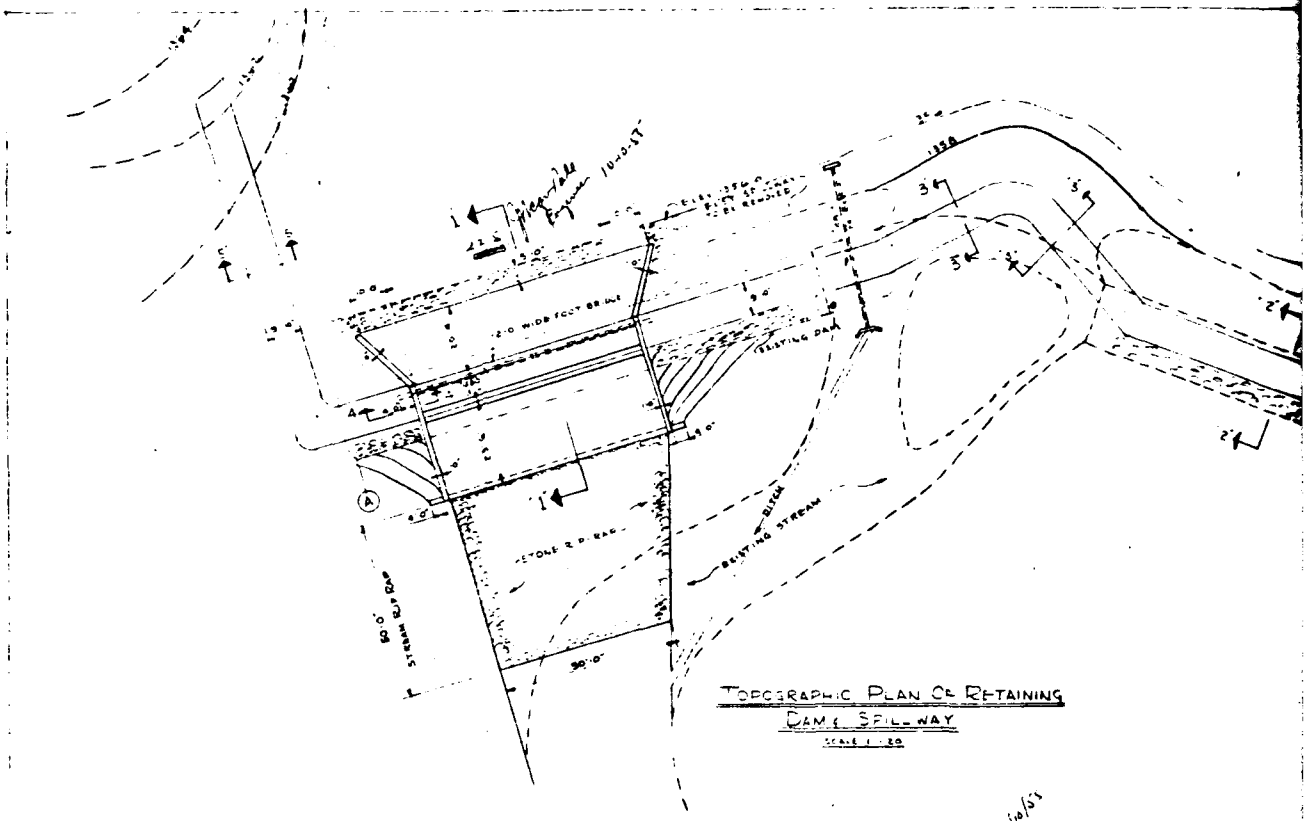
	PMF	½ PMF
Rainfall (inches)	24.42	12.21
Runoff (inches)	22.42	11.21
Peak Inflow (cfs)	5,758	2,859
Peak Outflow (cfs)	5,438	2,175
Depth of Overtopping (ft)	1.74	0.15
Duration of Overtopping (hr)	5.00	1.25


UNNAMED DAM
WILDWOOD LAKE DAM
MAINTENANCE BUILDING
APPROXIMATE MINIMUM LIMITS OF DOWNSTREAM FLOODING SHOULD DAM FAILURE OCCUR
ROAMINGWOODS LAKE DAM
ADDITIONAL POSSIBLE DAMAGE AREAS COVERED IN PHASE I REPORT FOR ROAMINGWOODS LAKE DAM
NOTES:
1. LIMITS OF DOWNSTREAM FLOODING ARE ESTIMATES BASED ON VISUAL OBSERVATIONS.
2. CIRCLED NUMBERS INDICATE STATIONS USED IN COMPUTER ANALYSIS.
3. THIS MAP SHOULD NOT BE USED IN CONNECTION WITH THE EMERGENCY OPERATION AND WARNING PLAN.
2000 0 2000
SCALE: 1 IN. = 2000 FT.
PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
WILDWOOD LAKE DAM
WILDWOOD PARK OUTING CLUB, INC.
DOWNSTREAM DEVELOPMENT PLAN
MARCH 1981
EXHIBIT D-1

APPENDIX E

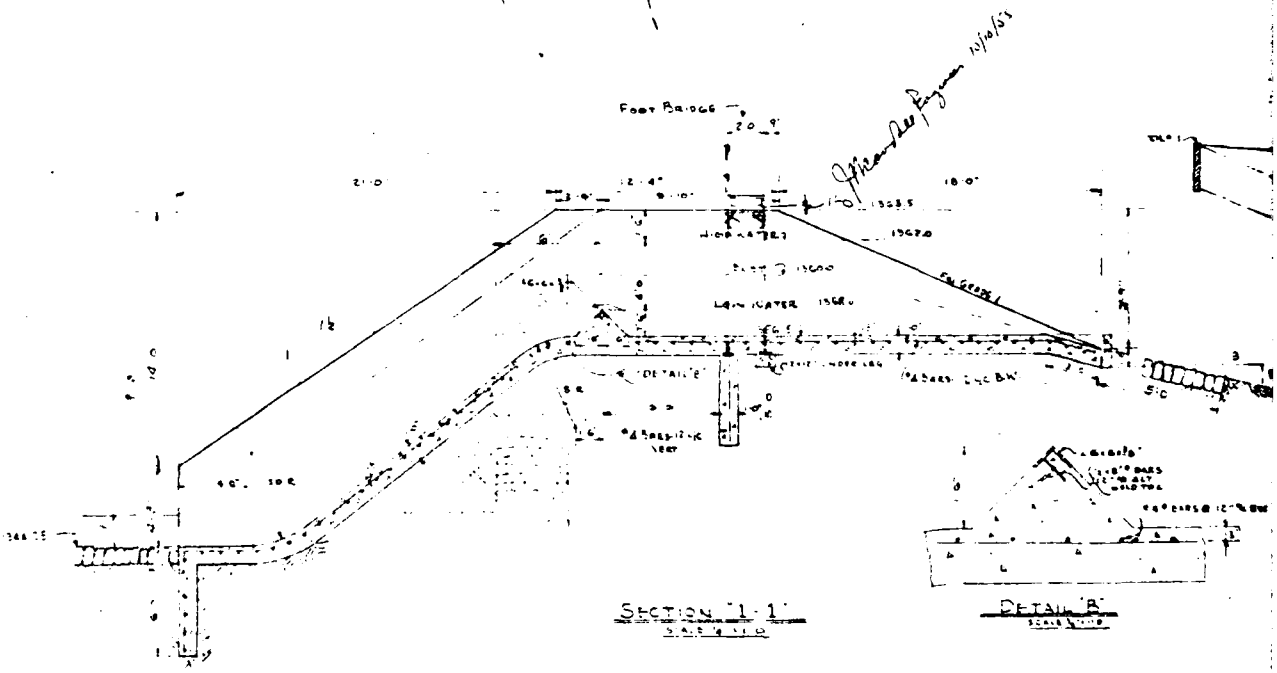
PLATES


WILDWOOD LAKE DAM
7 1/2 MINUTE QUADRANGLE
LAKEVILLE, PA.
UNNAMED DAM
WILDWOOD LAKE DAM
ROAMINGWOODS LAKE DAM
ARIEL CREEK
LAKE GENERO
2000 0 2000
SCALE: 1 IN. = 2000 FT.
PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
WILDWOOD LAKE DAM
WILDWOOD PARK OUTING CLUB, INC.
LOCATION MAP
MARCH 1981
PLATE E-1



TOPOGRAPHIC PLAN OF RETAINING DAM & SPILLWAY

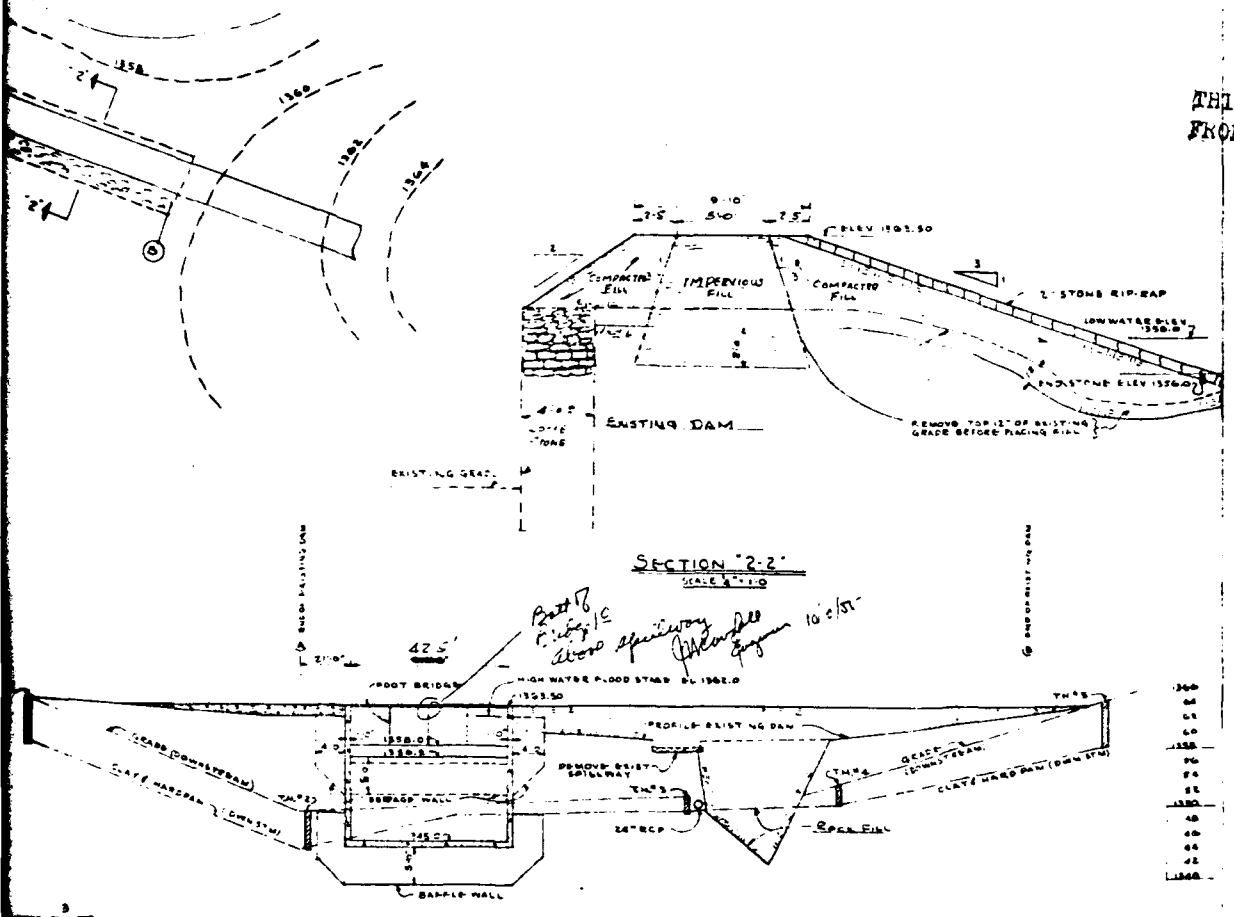
SCALE 1" = 20'



SECTION "1-1"

SCALE 1" = 10'

DETAIL "B"



NOTES

REMOVE SOD/SOIL TO DEPTH OF 12" MIN. WITHIN LIMITS OF WORK
ALL FILL TO BE PLACED AND ROLLED IN 6" LAYERS
CONCRETE F'c = 2500 PSI

PHASE I INSPECTION REPO
NATIONAL DAM INSPECTION PR
WILDWOOD LAKE DA
WILDWOOD PARK OUTING CL
PLAN AND SECTIO
SHEET 1 OF 2
MARCH 1981 PLA

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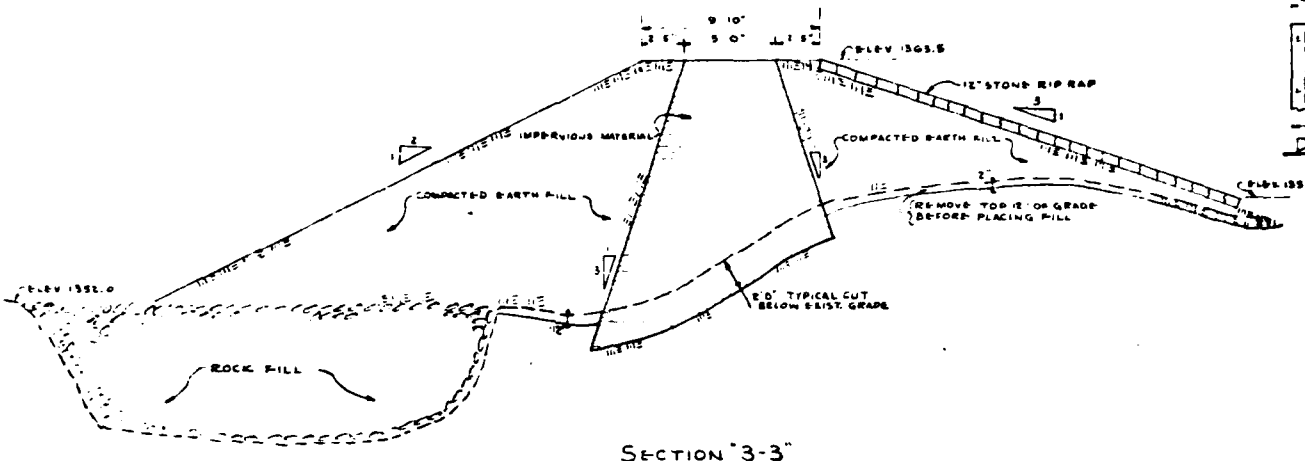
ECTION REPORT
SPECTION PROGRAM
LAKE DAM
OUTING CLUB, INC
SECTIONS
1 OF 2
PLATE E-2



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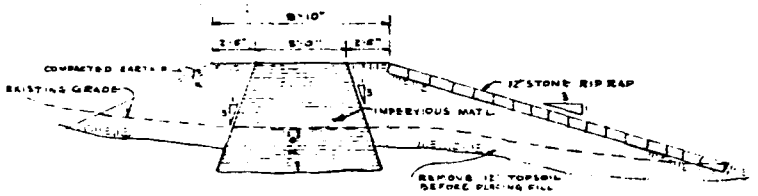

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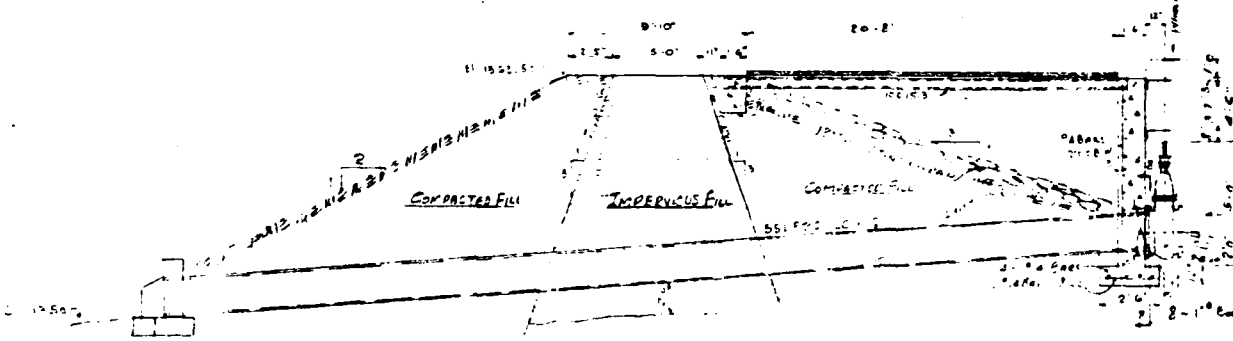

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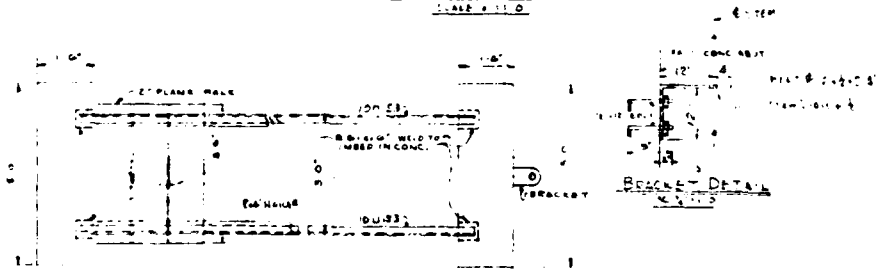
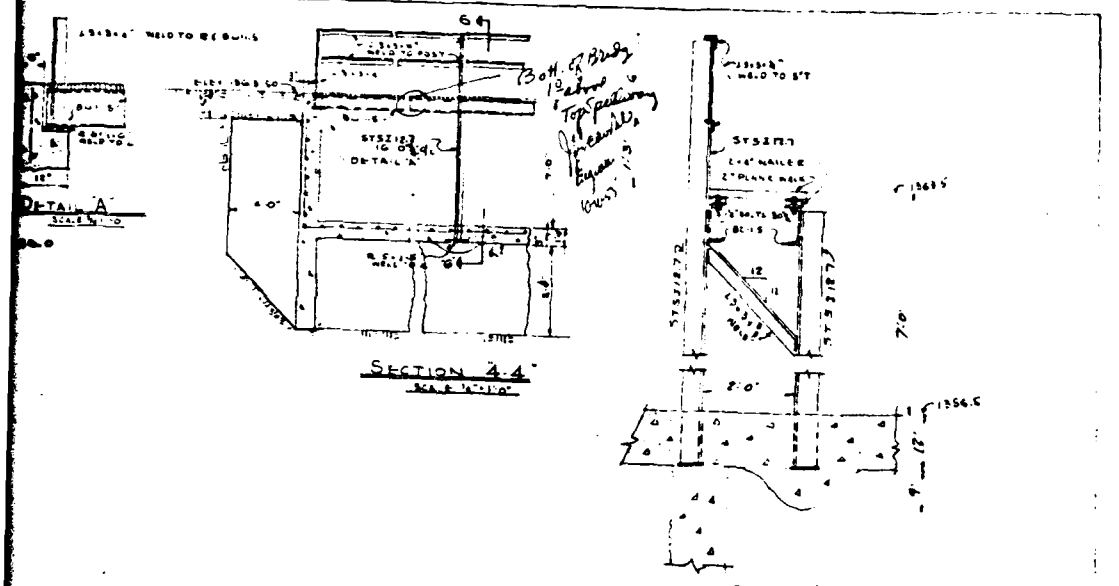
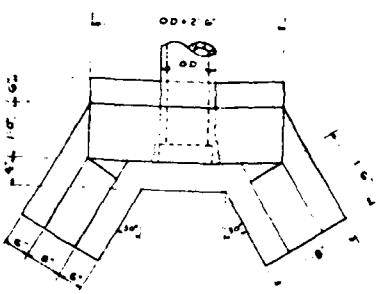
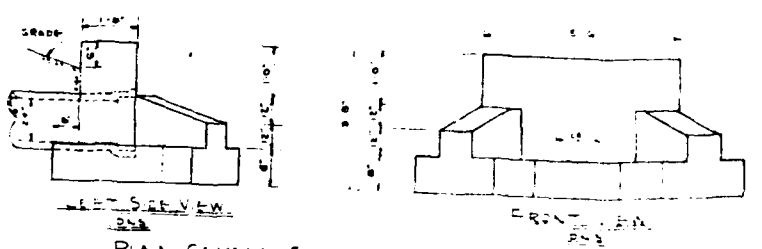


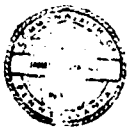
PLAN SHOWING FOOT BRIDGE

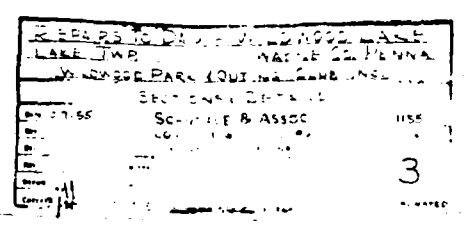
BRACKET DETAIL











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PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

WILDWOOD LAKE DAM

WILDWOOD PARK OUTING CLUB, INC.

PLAN AND SECTIONS
SHEET 2 OF 2

MARCH 1981 PLATE E-3

2

APPENDIX F

GEOLOGY

WILDWOOD LAKE DAM

APPENDIX F

GEOLOGY

Wildwood Lake Dam is located in Wayne County within the Appalachian Plateau Physiographic Province. The most pronounced topographic feature in the area is Camelback Mountain, which is part of the Pocono Plateau Escarpment. The escarpment has a well-defined southwestward trend from Camelback Mountain; but is irregular between Camelback Mountain and Mt. Pocono, which lies to the north. Streams east of the escarpment drain directly to the Delaware River, while those to the west drain to the Lehigh River.

The Pocono Plateau Section lies to the west of the escarpment. This area is relatively flat, with local relief seldom exceeding 100 feet. The topography has been greatly influenced by continental glaciation. Many features were created by deposition of glacial materials. The entire plateau lacks well-developed drainage.

East of the escarpment is the Glaciated Low Plateaus Section of the province. This area is characterized by preglacial erosional topography with locally-thick glacial deposits. Local relief is generally 100 to 300 feet.

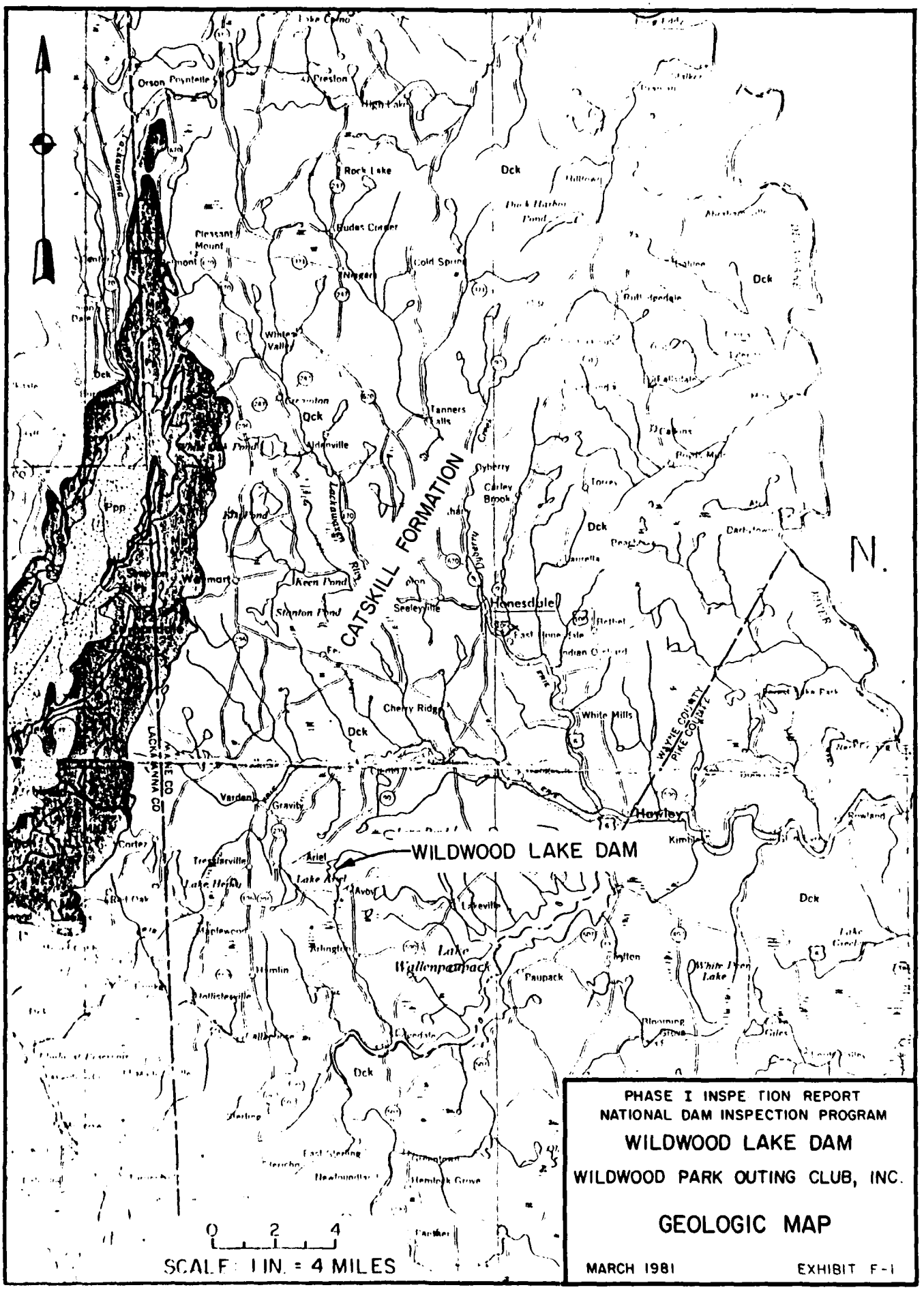
Bedrock units of the sections described above are the lithified sediments of offshore marine, marginal marine, deltaic environments and fluvial environments associated with the Devonian Period. These units include siltstones of the Mahantango Formation, siltstones and shales of the Trimmers Rock Formation, and seven mapped members of the Catskill Formation. These members include sandstones, siltstones, and shales of the Towamensing Member; sandstone, siltstone and shale of the Walcksville Member; sandstones, siltstones and shale of the Beaverdam Run Member; sandstone and shale in the Long Run Member; sandstones and conglomerates in the Packerton Member; sandstones and some conglomerates in the Poplar Gap Member; and sandstones and conglomerates in the Duncannon Member.

Wildwood Lake Dam is underlain by the Poplar Gap Member of the Catskill Formation. The Poplar Gap Member is predominantly a gray sandstone and conglomeratic sandstone with interbedded siltstones and shales. Sandstones present are thick-bedded, fine-to coarse-grained and exhibit very low primary porosity due to a clay and silica matrix. Effective porosity results from fractures and parting planes.

Conglomeratic sandstone occurs primarily as concentrates of subround to round quartz pebbles. The siltstones and shales at the site are thin-bedded and also have low porosity.

The rocks are well-indurated and generally are not susceptible to slope failure; however, the presence of well-developed bedding and joint planes will result in some rockfall from vertical and high-angle cut slopes.

Bedrock is entirely overlain by glacial till of Late Wisconsin Age. This till is an unsorted mixture of clay, silt, sand, and gravel. It is moderately cohesive and is generally derived locally from the sandstones of the Catskill Formation. Thickness of the till varies from 5 to 75 feet.



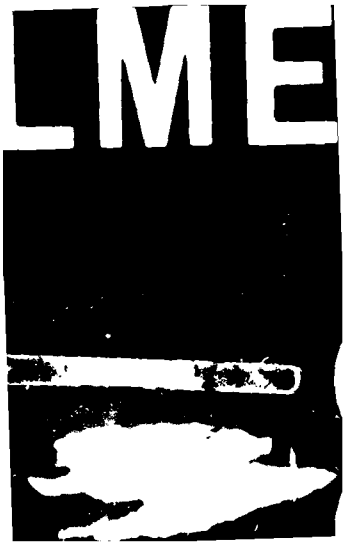
PHASE I INSPE TION REPORT
NATIONAL DAM INSPECTION PROGRAM

WILDWOOD LAKE DAM

WILDWOOD PARK OUTING CLUB, INC.

GEOLOGIC MAP

MARCH 1981 EXHIBIT F-1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